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EXPERIMENTAL INVESTIGATION OF A SUPERSONIC COMPRESSOR CASCADE

Sanford Fleeter, et al

General Motors Corporation

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This report describes in detail the experimental investigation of a stationary, linear, supersonic compressor cascade with blades of constant spanwise geometry and constant thickness linear sidewalls. The selected blade element was representative of streamline 19 of an advanced compressor configuration resulting from the Aerospace Research Laboratories axial compressor research program. The investigation covered the range of inlet relative Mach numbers of 1.535 - 1.683 and a range of static pressure ratios of approximately 1.1 - 2.3 and

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included laser velocimeter measurements of the flow within and around the cascade at the design Mach number.

PREFACE

This report was prepared by Sanford Fleeter, Robert L. Holtman, Robert B. McClure, and George T. Sinnet of the Research Department, Detroit Diesel Allison Division, General Motors Corporation, Indianapolis, Indiana. Significant assistance in acquiring the performance data described herein was provided by John W. Kurzrock.

Presented herein are results from a portion of the effort of the Fluid Dynamics Section. The work was conducted under Contract No. F33615-71-C-1766, Project No. 7065.

This work was sponsored by the Fluid Mechanics Research Laboratory of the Aerospace Research Laboratories. The Air Force contract monitor was Dr. Arthur J. Wennerstrom.

This report describes the work conducted under this program during the period of December 1973 through January 1975. Prior work conducted under this contract during the period of July 1971 through April 1973 was reported previously: ARL 72-0170, Vol. I (AD756870); ARL 72-0170, Vol. II (AD756871); ARL 73-0141 (AD774454); ARL 73-0142 (AD774549).

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF ILLUSTRATIONS

SECTION I

INTRODUCTION

Detroit Diesel Allison has designed, fabricated, and tested a linear, stationary, supersonic compressor cascade with blades of constant spanwise geometry and constant thickness linear sidewalls. The objective of this program has been to obtain cascade-type aerodynamic performance data and also laser velocimeter measurements of the flow within and around a cascade of a selected blade element from the latest compressor configuration resulting from the Aerospace Research Laboratories in-house program of research on axial compressors described in Reference 1.

The DDA cascade consists of six blades with a design inlet relative Mach number value of 1.616. The inlet relative axial component Mach number was subsonic. As laser velocimeter measurements and schlieren photography were important features of this research program, a two-dimensional linear test was chosen. Porous bleed strips which are not optically restrictive were used to remove the sidewall boundary layers.

The cascade was fully instrumented, including static pressure taps (sidewall inlet, blade surface, and exit sidewall), inlet total pressure and temperature instrumentation, traversing cone probe in the exit flow field, test section angular position, probe position, and laser velocimeter. Experimental data from all of the instrumentation were obtained with an on-line computer controlled data acquisition system. Schlieren photography was also used to obtain important information on cascade flow conditions.

Cascade performance data were obtained at 24 flow conditions which consisted of 9, 8, and 7 static pressure ratios at each of three relative Mach numbers corresponding to 95%, 100%, and 105% design speed, respectively. The Mach numbers were 1.535, 1.616, and 1.683. After the completion of this work, the center portion of one of the plexiglas windows was replaced with a glass insert, and the laser velocimeter measurements were made. At the design inlet Mach number blade-to-blade traverses were made across the central flow passage at the cascade inlet plane, at two passage planes, and at the cascade exit plane. Each of these traverses consisted of ten measurements. In addition, as a part of the DDA Independent Research and Development program, traverses were made at the same location as the cone probe and also at mid-spacing in the chordwise direction. These measurements were completed at two cascade static pressure ratios representative of a low and a high static pressure ratio.

This report describes the above work and includes information about the cascade design, instrumentation, data reduction procedures, and correlates the performance test results with the design characteristics. Appendices cover redefinition of the rotor geometry, data reduction equations, an explanation of the format for each data set, the 24 cascade performance data sets, and tables of laser velocimeter results.

SECTION II

CASCADE DESIGN

The cascade was designed to be operated in the supersonic wind tunnel shown in Figure 1. This tunnel uses 10 lb/sec of filtered, dried, and temperature controlled air and is in a continuous flow, non-return type system. The exit of the test section is evacuated by steam ejectors which can maintain an exit pressure of 6 psia at a flow rate of 10 lb/sec. The boundary layers from the nozzle blocks are removed through the upper and lower bleed ducts. An auxiliary steam ejector is used to remove sidewall boundary layers. The test section is mechanized so that a cascade of airfoils can be rotated while the tunnel is operating.

A number of general factors should be considered in the design of a cascade experiment for investigation of the flow characteristics for this type of compressor blading. First, consideration must be given to establishing the proper inlet flow conditions with the desired inlet velocity, flow direction, and simulation of an infinite cascade. Second, consideration must be given to the appropriate modifications of the rotor blade geometry so as to lead to some degree of equivalency when converted from the three-dimensional rotor design to the two-dimensional cascade. Third, the exit conditions must be set up correctly, for they are no less important, or less difficult to simulate properly, than the inlet flow conditions. Finally, the experiment should be designed to yield the desired information in its final form at the conclusion of the experiment, i.e., with parameters of interest calculated and, where desirable, plotted.

With respect to the cascade inlet conditions, consideration must be given to flow velocity, flow direction, and the setting up of a repeating flow pattern to simulate an infinite cascade. The following features are incorporated in the cascade design in order to provide the desired inlet flow conditions.

- Upstream wedge. A sharp wedge is independently mounted upstream of the cascade. The inlet flow direction is determined by the orientation of the wedge with respect to the airfoils. The cascade inlet Mach number is

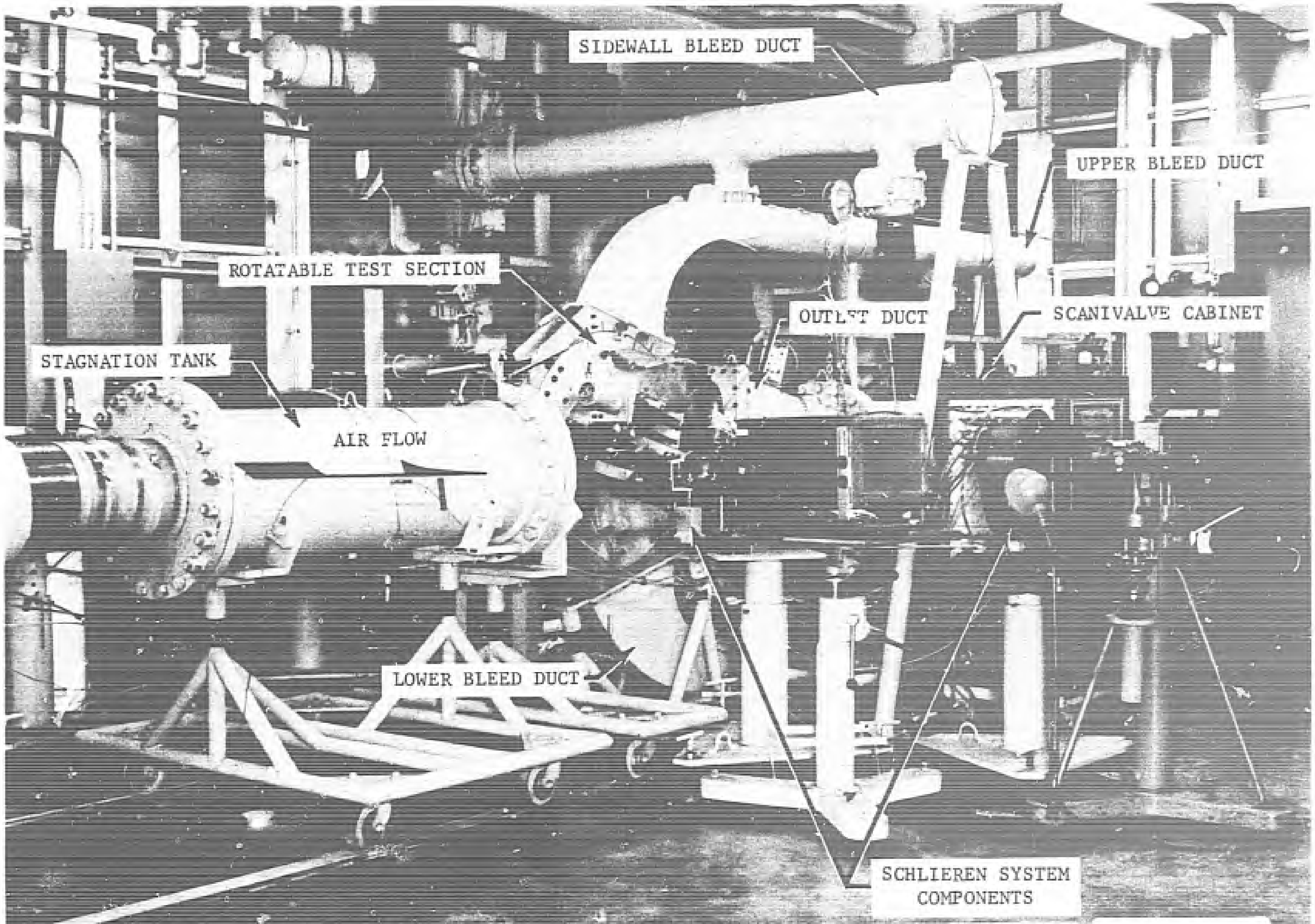


Figure 1. Overall View of Supersonic Wind Tunnel with Cascade Assembly

determined by the orientation of the wedge with respect to the nozzle flow. The cascade inlet velocity is controlled by either expanding or shocking the nozzle flow off of the wedge. This is accomplished by rotating the test section with respect to the nozzle.

- Sidewall boundary layer control. The wind tunnel sidewall boundary layer control system has the capability of removing the boundary layers on all four tunnel sidewalls prior to the flow's entering the cascade test section. The supersonic nozzle boundary layers are removed by utilizing a bleed system (top and bottom). In order to obtain the desired two-dimensional cascade configuration and control sidewall boundary layer-cascade interactions, a sidewall boundary layer control system is also employed. As laser velocimeter measurements and schlieren photographs are a major part of the research program, porous bleed strips are used upstream of the windows, as they are not optically restrictive.

- Static pressure taps. An important aspect of the inlet flow problem is the ability to verify that the conditions desired have, in fact, been achieved. For this purpose, there were six static pressure taps in one sidewall approximately 0.25 in. ahead of the leading edge of each blade.

- Schlieren system. The schlieren system is used to verify the inlet, passage, and exit flow fields, the flow off the wedge, and the operation of the top and bottom bleed system. It also can be employed to indicate when the cascade spill conditions have been reached.

The cascade tested was intended to represent the two-dimensional aerodynamic equivalent of the rotor blade section corresponding to streamline 19 of the ARL-designed compressor described in Reference 1. Since LV measurements within and around the cascade were a major feature of this research program and schlieren photographs were also desired, a two-dimensional test was chosen (in contrast to a quasi-three-dimensional test with converged sidewalls as described in Reference 2) because of practical and economic considerations related to the required optically transparent sidewalls. A modification to the geometry to simulate the three-dimensional conditions when tested in two-dimensions was considered feasible because of the moderate area contraction ratio of the adjacent streamtubes — about 11.3 percent.

The original set of parameters supplied by ARL describing streamline 19 of the rotor were converted by DDA to a two-dimensional equivalent cascade configuration. This conversion

was accomplished by duplicating the rotor inlet and exit Mach numbers, M_1 and M_2, and determining the cascade inlet and exit flow angles, β_1 and β_2, from the Tan β_∞ rule given in Eq. 1:

$$\left(\frac{\text{Tan } \beta_1 + \text{Tan } \beta_2}{2}\right)_{\text{Rotor}} \equiv \text{Tan } \beta_\infty \equiv \left(\frac{\text{Tan } \beta_1 + \text{Tan } \beta_2}{2}\right)_{\text{Cascade}} \qquad (1)$$

ARL then slightly modified the flow parameters so as to result in a close correlation of static pressure distribution between the design rotor streamline and the final two-dimensional cascade. Table I presents a comparison of the overall parameters of rotor streamline 19, the original DDA two-dimensional cascade design, and the final equivalent cascade configuration which was tested.

TABLE I
COMPARISON OF STREAMLINE 19 OF THE ARL ROTOR AND THE 2-D CASCADE CONFIGURATION

PARAMETER	STREAMLINE 19 OF ROTOR	2-D CASCADE (INITIAL DDA DESIGN)	2-D CASCADE (ARL FINAL DESIGN)
M_1	1.6117	1.6117	1.6117
β_1	55.582	55.85	55.85
M_2	.8809	.8809	.8833
β_2	53.934	56.93	56.752
P_2/P_1	2.1594	2.159	2.154
W_2/W_1	.6274	.6269	.62827
Wm_2/Wm_1	.7086	.6091	.6136
$W_{\theta_1}/W_{\theta_2}$	.5943	.6349	.6349
$\overline{\omega}$	.2338	.2246	.2246
σ	1.5294	1.5294	1.5294
β_∞	56.399	56.399	56.306

Once the overall parameters describing the two-dimensional blade characteristics had been established, the detailed redefinition of the blade geometry was accomplished by the ARL compressor design group. A description of the ARL redefinition of rotor streamline 19 is presented in Appendix A.

The cascade must be designed so that the exit will have the correct velocity and flow direction and be characterized by periodic spatial flow conditions. The application of back pressure must be uniform along the cascade and should not result in non-periodic flow conditions. Moreover, the cascade must be designed so that the application of back pressure does not influence the inlet flow conditions — at least until the spill condition is reached.

A number of cascade exit configurations have been investigated with the DDA wind tunnel facility. These have included the use of single perforated tailboards, double perforated tailboards, and the use of a dump diffuser. It has been found that the cascade design objectives with respect to the exit flow can be achieved through the use of double perforated tailboards. Best results are obtained if the sixth blade in the cascade serves as the leading section of the bottom tailboard.

Figure 2 shows a schematic of the compressor cascade configuration.

As previously discussed, the blade profile was based on the geometry of streamline 19 of the previously referenced ARL rotor design. This profile is shown schematically in Figure 3. The blade contour points are shown in Table II. The physical characteristics of the cascade are shown in Table III.

Figures 4 and 5 show views of the blade profile and of the instrumented blade, respectively. Figure 6 shows a view of the cascade in the wind tunnel with the glass insert in the plexiglas window for the laser velocimeter measurements.

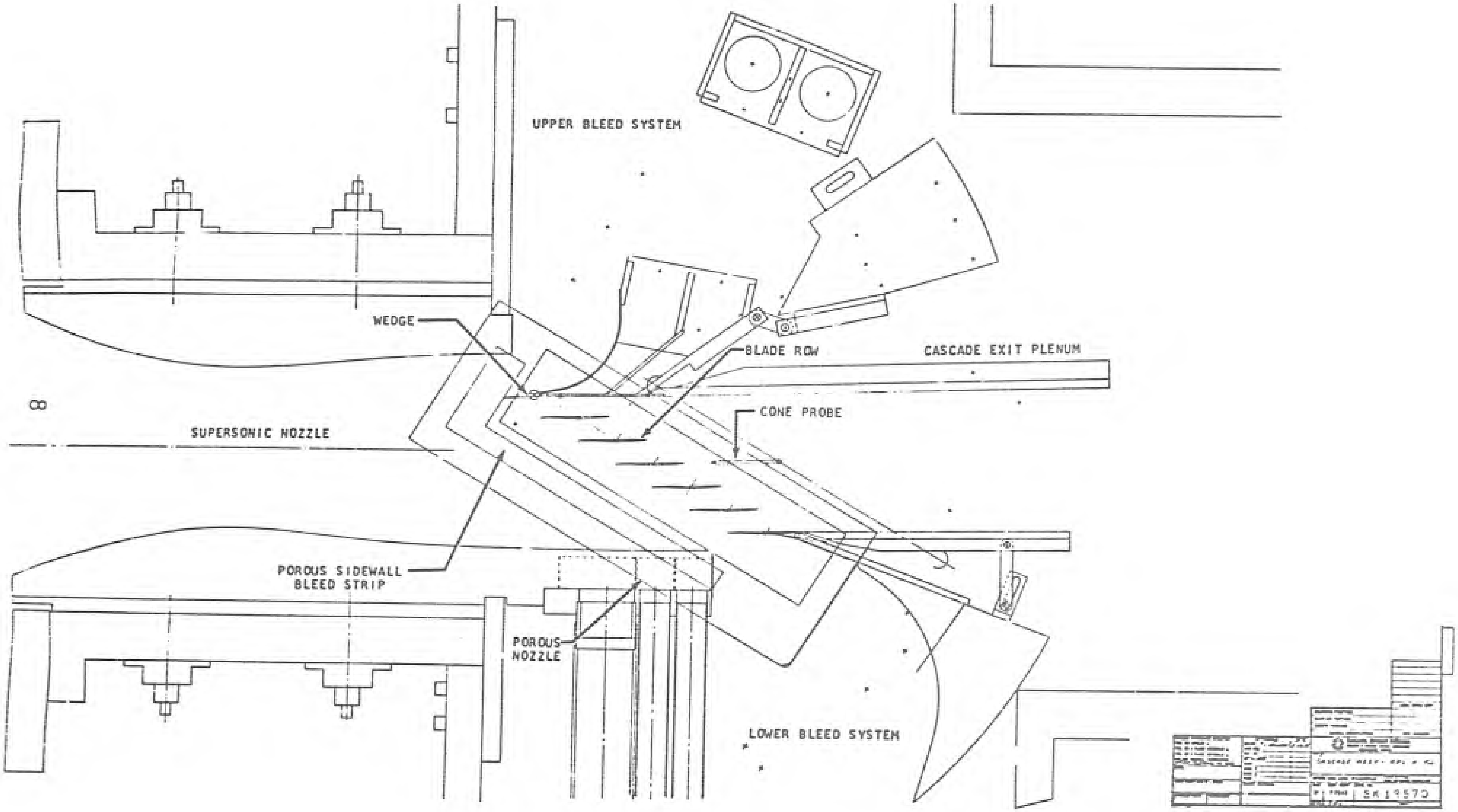


FIGURE 2. COMPRESSOR CASCADE SCHEMATIC

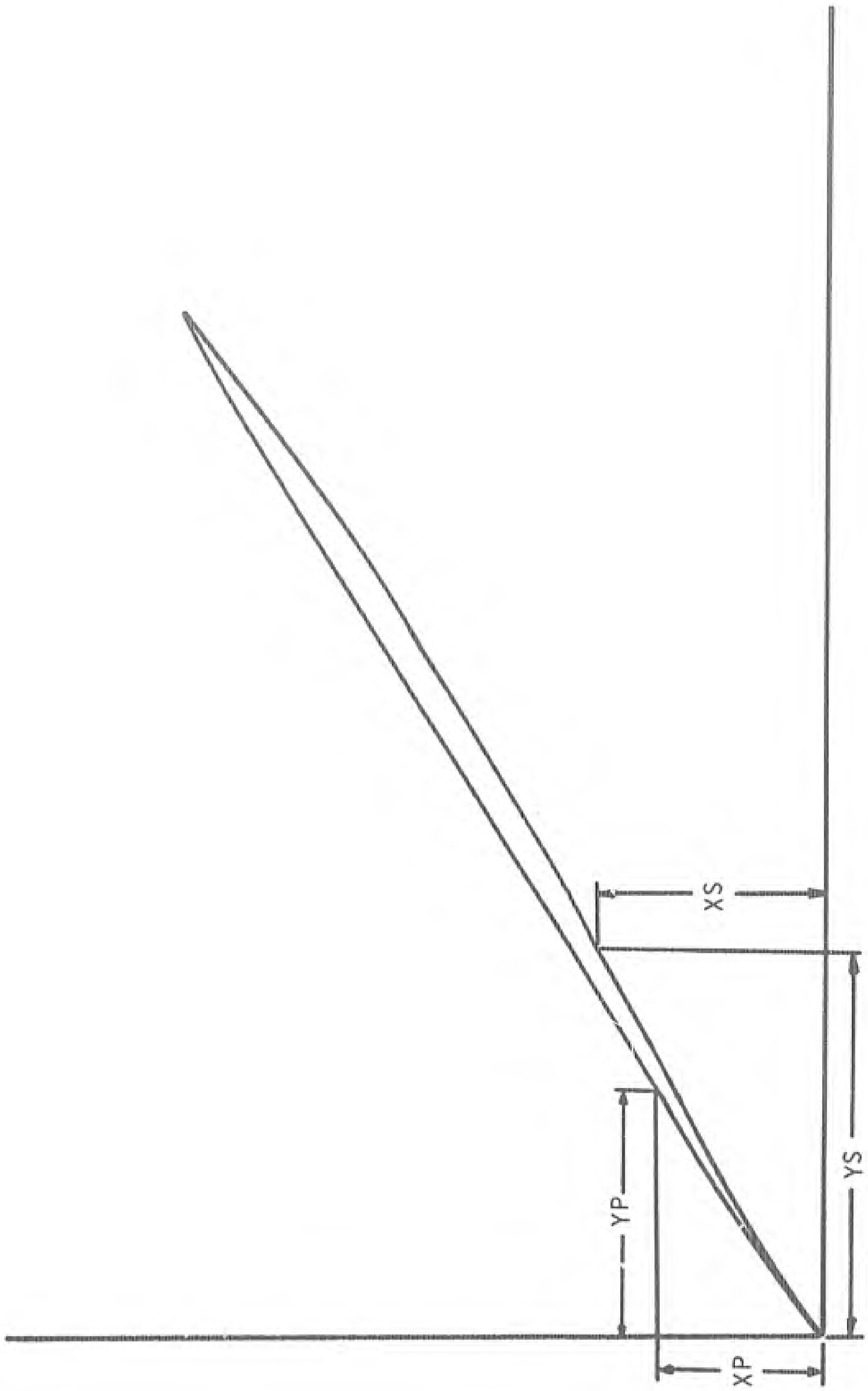


FIGURE 3. BLADE PROFILE

TABLE II
BLADE CONTOUR POINTS

STATION	XS	YS	XP	YP
1	0.0	0.0	0.0	0.0
2	-0.000858	0.005087	0.004661	0.000780
3	0.017358	0.029973	0.024148	0.024799
4	0.035559	0.055383	0.043650	0.049341
5	0.053745	0.081301	0.063167	0.074391
6	0.071917	0.107713	0.082700	0.099966
7	0.090073	0.134618	0.102247	0.126048
8	0.108214	0.162017	0.121809	0.152610
9	0.126355	0.189879	0.141371	0.179649
10	0.144481	0.218190	0.160948	0.207168
11	0.162608	0.246950	0.180524	0.235120
12	0.180719	0.276113	0.200116	0.263491
13	0.198815	0.305681	0.219708	0.292266
14	0.216927	0.335607	0.239300	0.321414
15	0.235038	0.365877	0.258907	0.350907
16	0.253134	0.396462	0.278499	0.380713
17	0.271246	0.427330	0.298091	0.410789
18	0.289357	0.458423	0.317668	0.441119
19	0.307483	0.489740	0.337260	0.471644
20	0.325624	0.521222	0.356822	0.503333
21	0.343766	0.552823	0.376384	0.533156
22	0.361922	0.584529	0.395931	0.564085
23	0.380093	0.616295	0.415448	0.595058
24	0.398279	0.648091	0.434965	0.626076
25	0.416480	0.679901	0.454467	0.657094
26	0.434696	0.711682	0.473955	0.688097
27	0.452927	0.743433	0.493427	0.719085
28	0.471173	0.775139	0.512869	0.750013
29	0.489449	0.806755	0.532297	0.780867
30	0.507739	0.838297	0.551709	0.811661
31	0.526045	0.869734	0.571107	0.842365
32	0.544381	0.901081	0.590474	0.872979
33	0.562731	0.932308	0.609827	0.903503
34	0.581097	0.963431	0.629164	0.933938
35	0.599478	0.994449	0.648472	0.964298
36	0.617888	1.025346	0.667780	0.994554
37	0.636313	1.056154	0.687058	1.024748
38	0.654754	1.086859	0.706306	1.054853
39	0.673224	1.117458	0.725539	1.084885
40	0.691709	1.147967	0.744757	1.114856
41	0.710224	1.178368	0.763945	1.144737
42	0.728754	1.208702	0.783118	1.174559
43	0.747299	1.238913	0.802261	1.204306
44	0.765874	1.269033	0.821390	1.233977
45	0.784479	1.299049	0.840488	1.263560
46	0.803099	1.328961	0.859571	1.293082
47	0.821749	1.358768	0.878625	1.322515
48	0.840428	1.388470	0.897649	1.351873
49	0.859123	1.418067	0.916657	1.381142
50	0.877847	1.447530	0.935636	1.410320
51	0.896602	1.476888	0.954585	1.439408
52	0.915386	1.506110	0.973504	1.468392
53	0.934185	1.535199	0.992393	1.497272
54	0.953014	1.564167	1.011266	1.526061
55	0.971873	1.593002	1.030110	1.554746
56	0.990763	1.621702	1.048924	1.583326
57	1.009665	1.650253	1.067723	1.611816
58	1.028615	1.678683	1.086478	1.640203
59	1.047608	1.706965	1.105187	1.668514
60	1.066647	1.735096	1.123853	1.696751
61	1.085731	1.763079	1.142457	1.724911
62	1.104889	1.790911	1.161017	1.753013
63	1.124106	1.818593	1.179487	1.781055
64	1.143399	1.846128	1.197913	1.809068
65	1.162767	1.873526	1.216233	1.837049
66	1.182209	1.900761	1.234494	1.865016
67	1.201756	1.927876	1.252650	1.892968
68	1.221394	1.954824	1.270717	1.920935
69	1.241135	1.981655	1.288679	1.948903
70	1.260981	2.008322	1.306520	1.976885
71	1.280947	2.034868	1.324258	2.004911
72	1.301032	2.061264	1.341876	2.032969
73	1.321238	2.087526	1.359374	2.061070
74	1.341592	2.113639	1.376722	2.089216
75	1.362082	2.139617	1.393937	2.117588
76	1.382705	2.165445	1.411016	2.145719
77	1.403493	2.191140	1.427931	2.174074
78	1.424431	2.216669	1.444696	2.202506
79	1.445534	2.242048	1.461297	2.231026
80	1.466801	2.267280	1.477718	2.259636
81	1.488247	2.292359	1.493976	2.288336
82	1.491111	2.290347	1.491111	2.290347

TABLE III
CASCADE PHYSICAL CHARACTERISTICS

Chord	2.733 in.
Axial Chord	1.491 in.
Blade Spacing	1.787 in.
Blade Span	3.018 in.
Maximum Thickness/Chord Ratio	0.0255
Metal Angle-Leading Edge Pressure Surface	50.947°
Metal Angle-Leading Edge Suction Surface	53.797°
Mean Camber Angle-Leading Edge	52.032°
Mean Camber Angle-Trailing Edge	54.923°
Stagger Angle (Setting Angle)	56.934°
Camber Angle	- 2.891°
Solidity	1.5294
Probe Measuring Station - Axial Distance Downstream of Trailing Edge Plane	0.68 in.

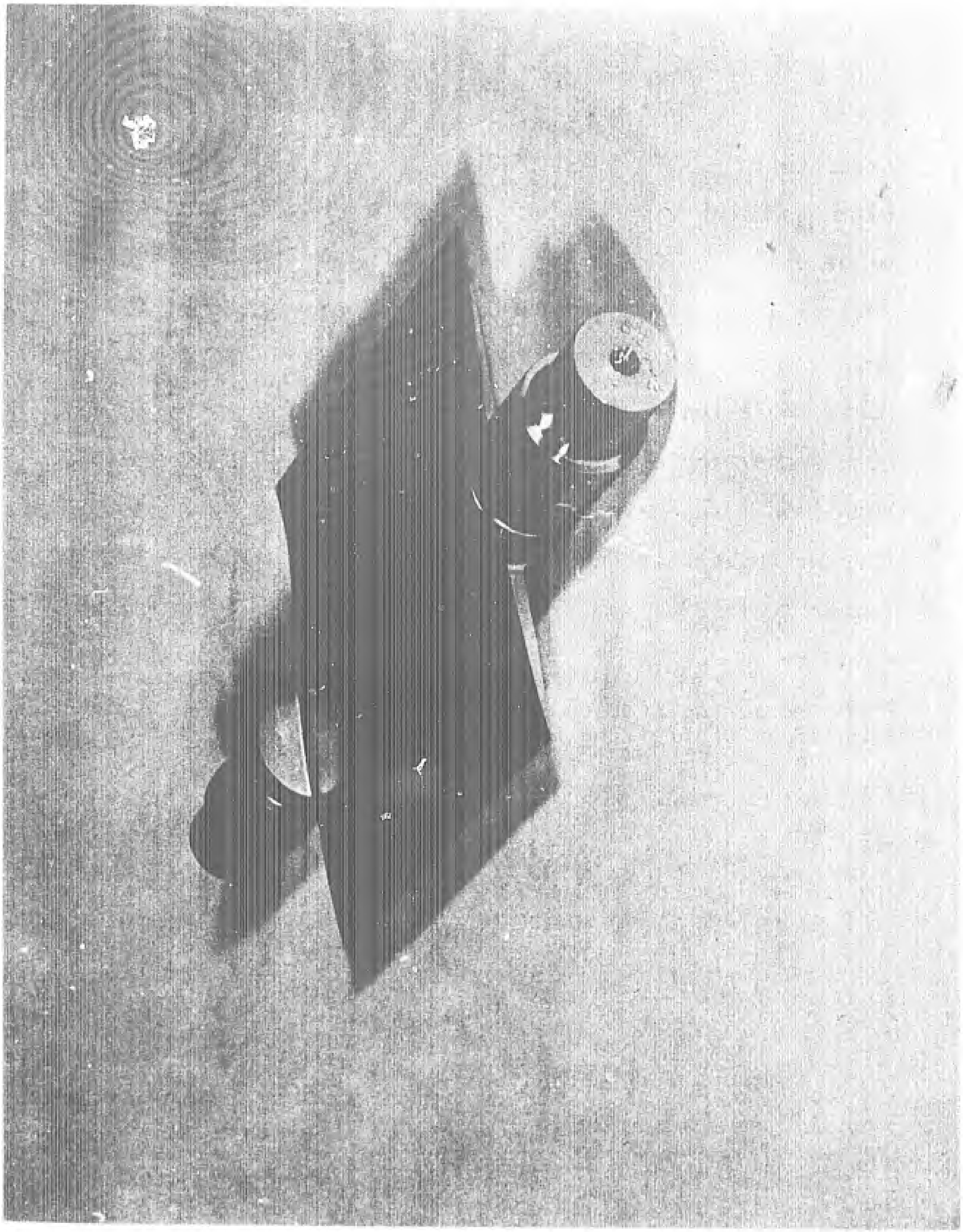


FIGURE 4. VIEW OF BLADE

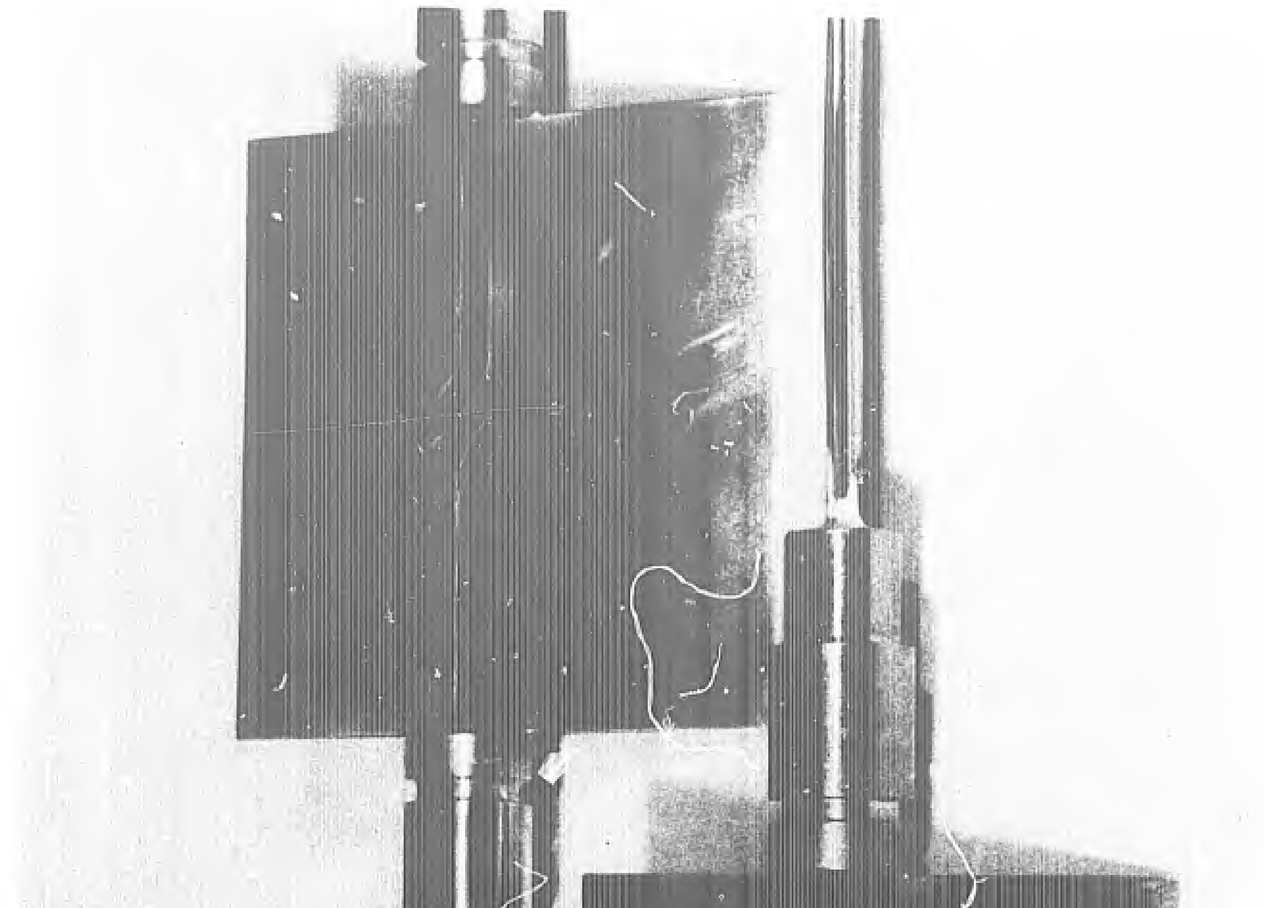


FIGURE 5. INSTRUMENTED BLADE

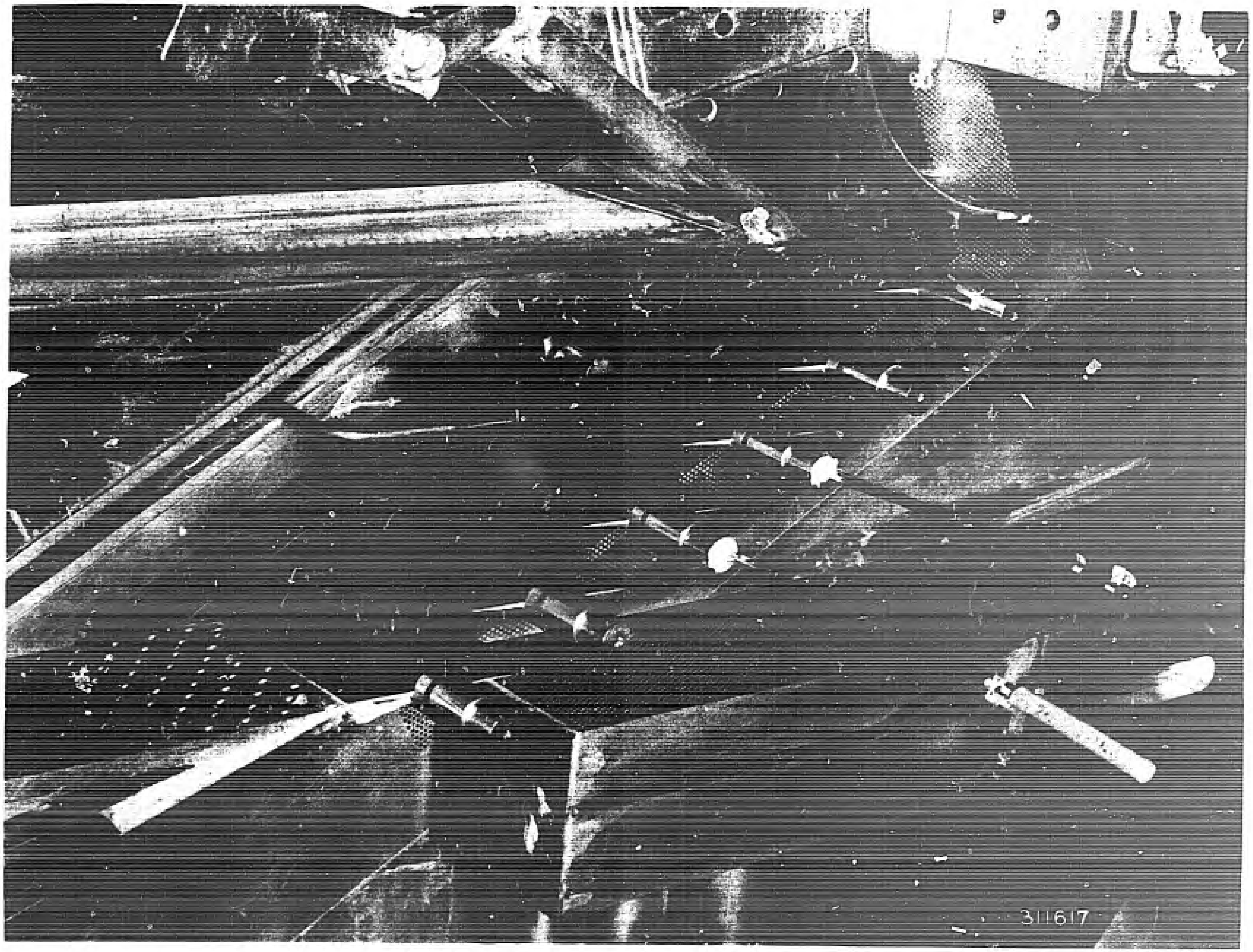


FIGURE 6. CLOSE-UP OF CASCADE ASSEMBLY IN WIND TUNNEL

SECTION III

INSTRUMENTATION

1. CASCADE PERFORMANCE

The wind tunnel used in this program is equipped with a sophisticated instrumentation system for the investigation of airfoil aerodynamic characteristics. The instrumentation system is centered around a laboratory-size digital computer to provide rapid on-line data acquisition and reduction. This computer has a 22,000 word core memory with a 16-bit word length. Memory cycle time is 0.98 μsec. Peripheral equipment includes a CRT terminal, 80 column line printer (350 to 1100 lines per minute), high-speed punch, a high-speed punched tape reader, an X-Y digital plotter, and a magnetic disc storage unit with 2.5×10^6 word capacity. (See Figure 7.)

The use of the computer makes it possible to acquire raw data, convert them to engineering units, and make computations while the experiment is in progress. This enables personnel to evaluate the experimental data during the test and results in maximum collection of scientific and engineering information for any program investment. Decisions to repeat some phases of the test can be made instantly. Also, optimum running conditions can be determined as well as the need for additional data to make the test more meaningful and nearly complete.

The computer is used for control of instrumentation, data acquisition, and data reduction. In the control mode, the computer operates a digital voltmeter, an electronic scanner, Scanivalve stepping motors, indexer for positioning the conical probe, and the computer peripheral equipment. During wind tunnel operation, the computer is capable of acquiring automatically any data required to determine the performance characteristics of the cascade being tested. Pressure measurements are obtained by utilizing a Scanivalve system incorporating four 48 port rotary valves (Scanivalves) providing a total pressure measurement capacity of 192 pressures. Differential pressure measurements are obtained from individual pressure transducers as required. In addition, up to 48 temperature measurements are possible. Other necessary wind tunnel data which are measured by the computer include test section angular position (used to define the cascade inlet Mach number and flow direction) and conical probe position (angular, horizontal, and vertical).

During data acquisition, the computer performs two additional functions which can be easily accomplished by an on-line data acquisition system. The first seven ports on each of the four Scanivalves are used for three reference calibration

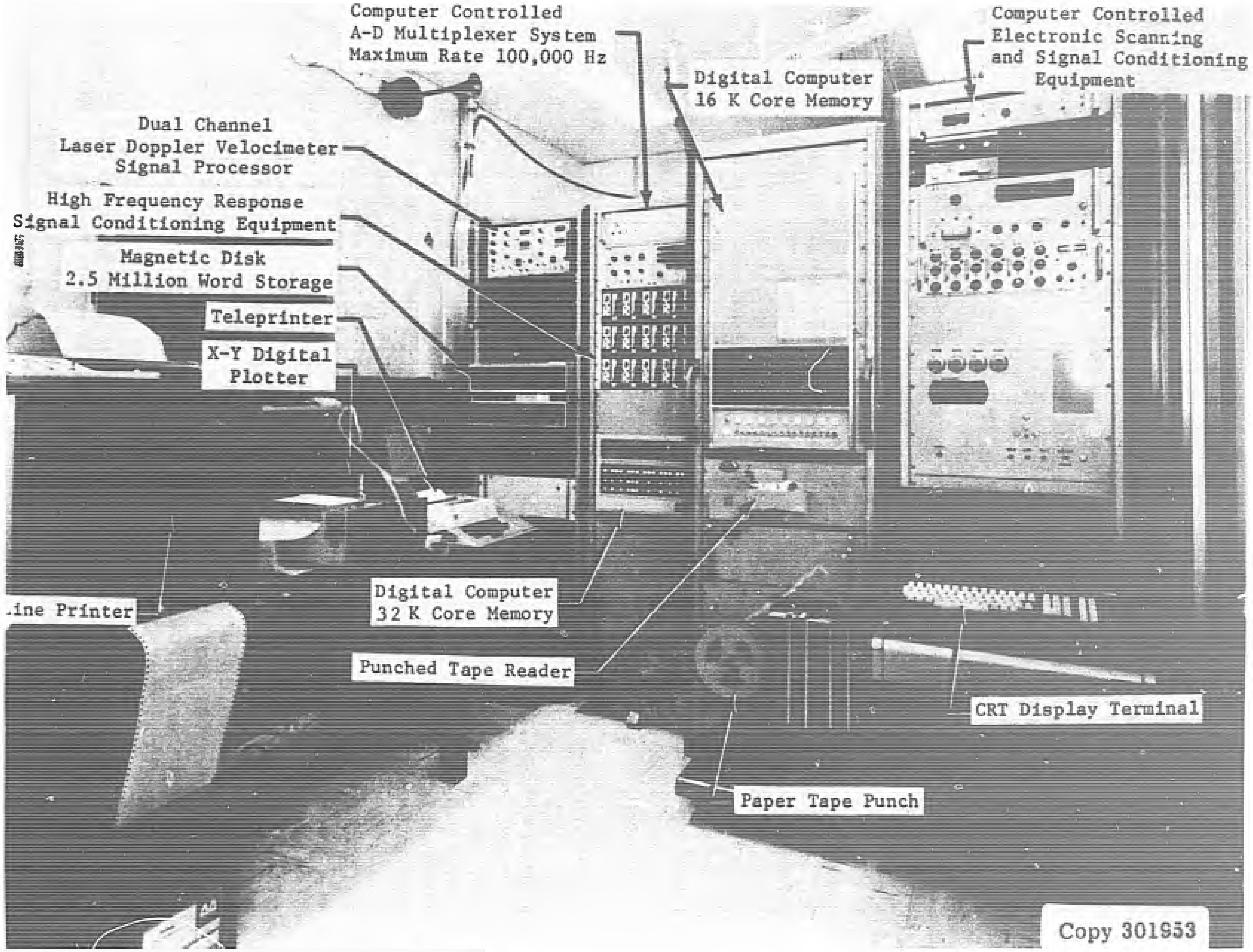


FIGURE 7. WIND TUNNEL ON-LINE DATA ACQUISITION SYSTEM

pressures. Each time the computer initiates a set of pressure readings the calibration pressures are measured, providing direct on-line calibration of the Scanivalve pressure transducers. Secondly, the wind tunnel total pressure and total temperature are monitored during data acquisition of each test point. If the pressure or temperature varies outside a preset tolerance, the computer automatically presents the out-of-limit reading(s) and waits for instructions. The immediate data can be rejected and remeasured, the data for the complete test point rejected and a new set of data initiated, or the out-of-limits condition overridden and the acquisition of data continued.

The computer also reduces the cascade test data on-line. As the data are acquired, the computer analyzes the data to determine not only the test operating conditions but also the complete performance characteristics of the cascade.

The desired test condition is established manually. The on-line instrumentation system then automatically completes the test condition data acquisition and reduction. This includes defining the cascade inlet flow field, positioning a conical probe at discrete points in the cascade passage to determine blade-to-blade flow field properties at the cascade exit, mass averaging and mixing to uniform flow conditions the blade-to-blade data to determine exit flow properties and overall performance, instrumented blade and sidewall passage performance, and plotting of instrumented blade parameters and blade-to-blade distribution of selected exit flow field properties. For each test condition, a total of about 450 measurements are made to define the cascade performance. The measurements, calculations, and print-out (11 pages) require 11 minutes, and the plotting requires 6 minutes.

The specific instrumentation used with this cascade is summarized as follows:

- Inlet total pressure.
- Inlet total temperature.
- There was one static pressure tap on each side of the tunnel located upstream of the wedge wave system.
- On one of the sidewalls were six static pressure taps approximately 0.25 in. ahead of the leading edge of each blade.
- The suction surface of blade 3 and the pressure surface of blade 4 were each instrumented with 10 static pressure taps. The location of each tap is included in each data set on the page of instrumented blade parameters.

- On one of the sidewalls approximately 0.87 in. axially downstream there were 10 static pressure taps. One tap was at each midpassage and four others centered around blade number 3.

- A cone probe was used to measure the exit Mach number, pressure, and direction at discrete locations across the cascade exit. Data were obtained 0.68 in. axially downstream from the cascade.

- Probe position.

- Test section rotor angle.

- Schlieren.

2. LASER VELOCIMETER

The DDA supersonic wind tunnel instrumentation system includes a two-dimensional laser velocimeter system (LV) which employs crossed-beams and operates in an off axis back-scatter mode. A two color system is employed so that orthogonal velocity components can be determined. The LV system has been interfaced to the wind tunnel digital computer, providing automated LV data acquisition and data analysis.

A schematic of the LV system is shown in Figure 8. The basic components of the system are a four watt argon laser, transmitting and receiving optics, photomultiplier tubes, and an electronic frequency counter signal processor. The argon laser beam contains many spectrographic lines of which two are predominant -- a blue line (wavelength of 488.0 nm) and a green line (wavelength of 514.5 nm). A prism is used to spread the laser beam into a spectrum of beams. The desired blue and green beams are intercepted and directed to beam splitters by appropriately positioning mirrors in the beam paths. The blue beam strikes a beam splitter which divides it into two parallel beams of equal intensity and separated by a distance of 0.799 in. The two parallel blue beams are focused by the transmitting lens (focal length of 30.0 in.) at a point within the wind tunnel test section. The crossing of the beams at the transmitting lens focal point results in an interference pattern's being established within the crossover volume. This interference pattern consists of alternating bright and dark regions or interference fringes. This pattern consists of approximately twenty-five (based on the beam splitter employed) fringe planes oriented perpendicular to the plane of the blue beams and parallel to the optical axis.

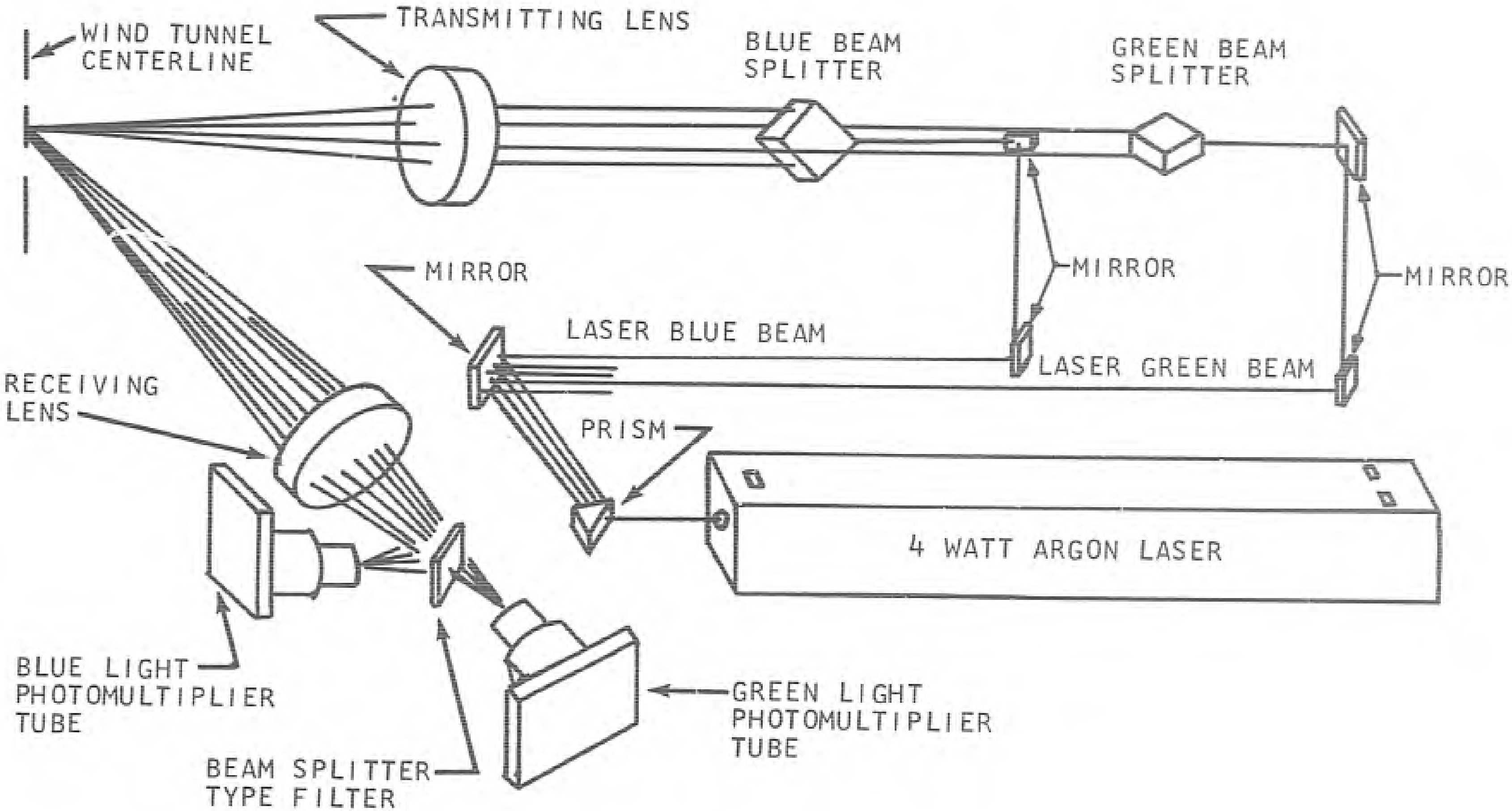


FIGURE 8. SCHEMATIC OF DDA TWO-DIMENSIONAL LASER VELOCIMETER SYSTEM

The green laser beam passes through a beam splitter which is positioned perpendicular to the plane of the blue beams. The two parallel green beams are then focused by the transmitting lens at the same point as the blue beams. This results in two overlapping interference patterns oriented perpendicular to each other. The fringe spacing for the green interference patterns is 63.35 micro-feet and 60.09 micro-feet for the blue.

Particles (naturally occurring or seed) passing through the crossover volume (focal region) will intercept the interference fringes. For this experiment, the air flow was artifically seeded by injecting 0.3 micron diameter (mean particle size) alumina into the wind tunnel stagnation chamber by means of a fluidized bed seeding mechanism. Illumination of the seed particle will fluctuate from a maximum to minimum as the particle passes from fringe to fringe. The fluctuating light radiation scattered by the particle(s) will consist of both blue and green light. The DDA LV system collects the backward scattered radiation, employing a receiving lens (focal length of 8.0 in.) positioned approximately 27.5 degrees from the transmitting lens. The receiving lens focuses the scattered radiation to a point. A beam splitter type filter is placed between the lens and its focal point to separate the blue and green scattered light. The filter transmits the green light and reflects the blue. Photomultiplier tubes are positioned at the focal points of the blue and green light. The electrical signal developed by each of the photomultiplier tubes is sinusoidal in nature and varies in frequency inversely proportional to fringe spacing and directly proportional to that component of particle velocity which is perpendicular to the fringe pattern.

Thus the output signals of the blue light photomultiplier tube and the green light photomultiplier tube provide sufficient information so that orthogonal velocity components (and therefore the resultant velocity vector magnitude and direction) can be determined. The photomultiplier tube signals are processed by a dual channel LV signal processor of the electronic frequency counter type. In general terms, each channel of the processor consists of an amplifier, counter, and comparator. The processor amplifies and filters the input signal from the photomultiplier tube. It incorporates two separate counters which determine particle passage time for 5 and 8 interference fringes by counting the cycles of a 100 MHz clock. The measured times are compared to determine if they are in the proper 5 to 8 ratio. If this ratio differs by more than a preset amount, the measurement is automatically rejected and the processor initiates another measurement. The comparison threshold is switch selectable. Valid data (passing the 5 to 8 ratio comparison test) are acquired by the wind tunnel on-line computer controlled data acquisition system at rates to 300,000 readings per second.

Figure 9 is an overall view of the LV system positioned to acquire experimental data from the ARL cascade in the DDA supersonic wind tunnel. The LV system components are mounted on an optical bench which is mounted on a modified vertical mill. The modified mill is fitted with stepping motors so that the blue and green beam crossover volume (test volume) can be positioned in three dimensions within the wind tunnel test section. Positioning of the LV test volume at the required traversing planes (cascade inlet, interpassage, and exit planes) and at the discrete test points along the planes can be accomplished remotely from the wind tunnel control room.

Figure 10 is a close-up view of the LV components on the optical table.

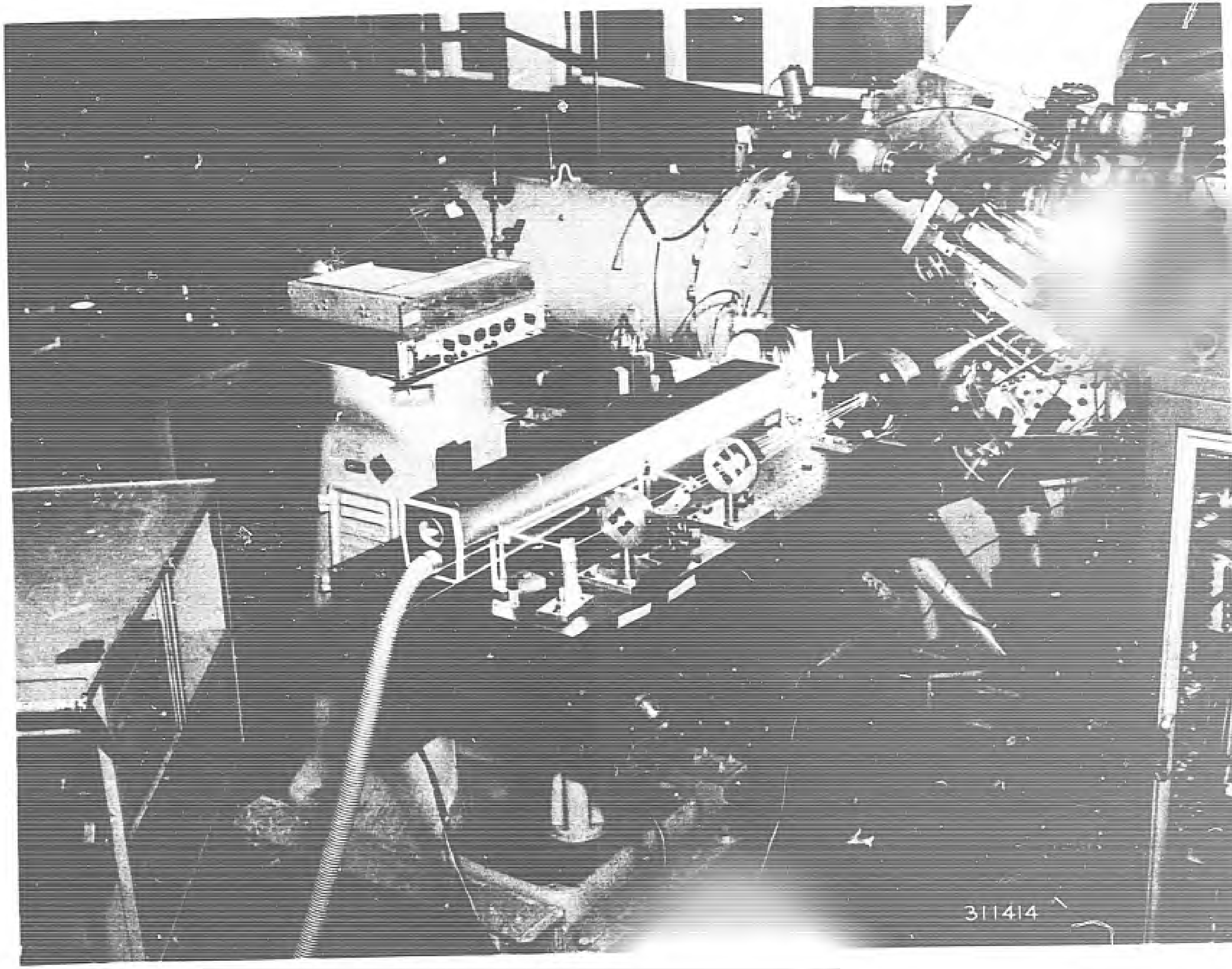


FIGURE 9. OVERALL VIEW OF DDA T[illegible]ER VELOCIMETER SYSTEM

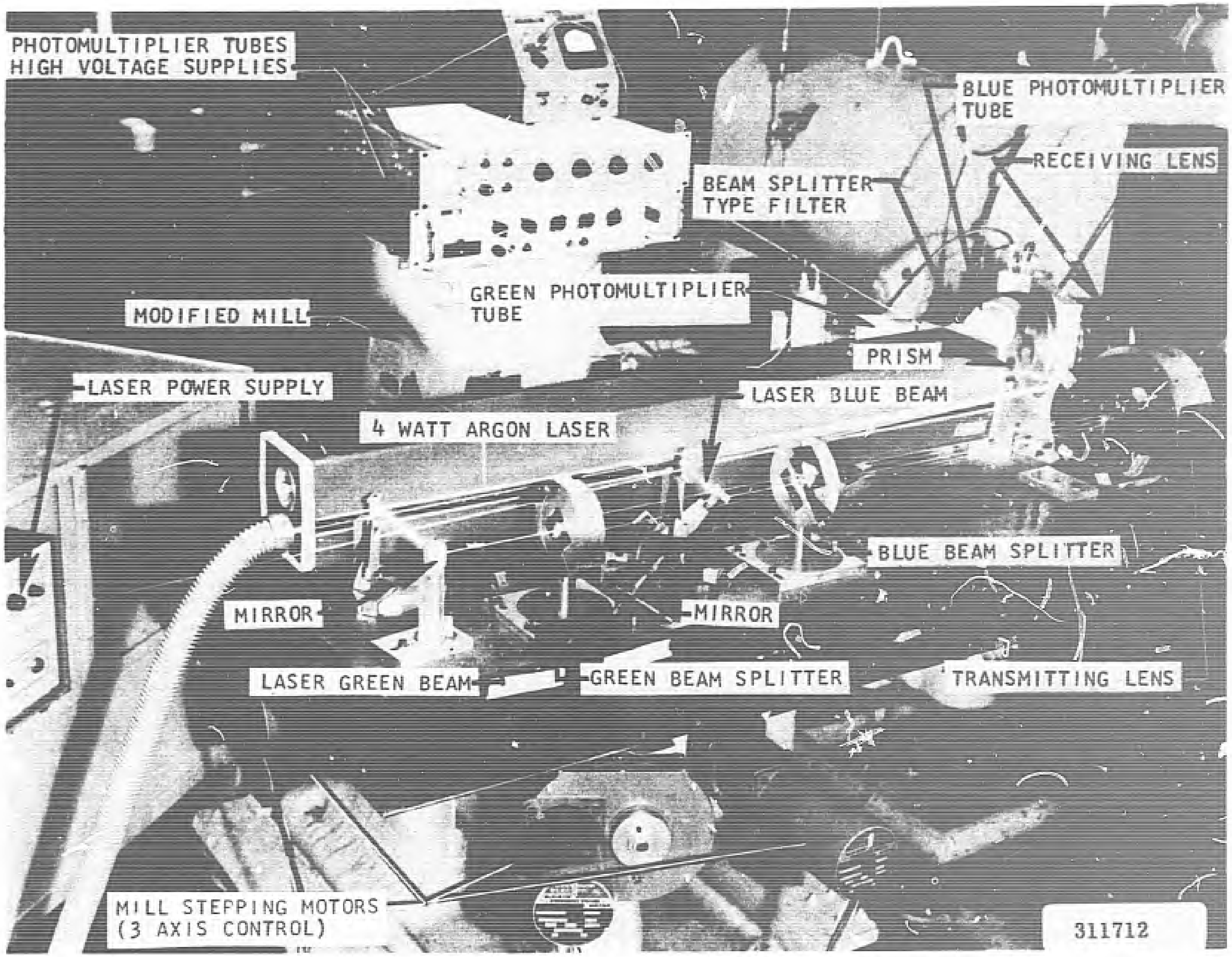


FIGURE 10. COMPONENTS OF THE DDA TWO-DIMENSIONAL LASER VELOCIMETER SYSTEM

SECTION IV

DATA REDUCTION PROCEDURES

1. CASCADE PERFORMANCE

The DDA Research Department supersonic wind tunnel on-line instrumentation system automatically acquires data from the wind tunnel, converts the data to engineering units, and makes computations while the experiment is in progress. Cascade experimental data and performance parameters can be evaluated during the test with the cascade operating characteristics available when the test is completed.

The wind tunnel on-line performance data reduction procedures are described in detail in Appendix B. In general, the data reduction program calculates the following cascade performance parameters:

- Cascade inlet flow field properties such as inlet relative Mach number, axial and tangential Mach number, mass flow rate, incidence angle, flow direction, static and total pressure, total temperature, and Reynolds number.

- Cascade exit flow field properties at discrete points across the passage such as conical probe location, Mach number, axial and tangential Mach number, static and total pressure, total pressure recovery, flow direction, deviation angle, and turning.

- Mass-averaging of discrete data (Mach number, total pressure recovery, and flow direction) and calculation of additional exit performance data such as total and static pressure. axial and tangential Mach number, total to static temperature ratio, and exit to inlet mass flow ratio.

- Cascade overall performance based on mass-averaged data such as static pressure ratio, total pressure recovery, velocity, density and static temperature ratio, total pressure loss coefficient, total pressure loss parameter, diffusion factor, equivalent diffusion factor, flow Reynolds number, static pressure rise parameter, deviation angle, turning, and area ratio.

- Cascade exit and overall performance based on a mixing loss analysis of the discrete data.

- Instrumented blade data and parameters such as local surface static pressure parameters, pressure ratios, net force and moment on the blades, and center of pressure.

The on-line data reduction program also includes computer controlled plotting of cascade performance parameters. The instrumented blade local surface static pressure rise parameter is plotted along with blade-to-blade cascade exit performance data.

A detailed listing of performance data reduction equations is presented in Appendix B.

2. LASER VELOCIMETER

A typical set of experimental LV data which was acquired under this contract is presented in Table IV. This data set describes the flow (seed particle) velocity and direction measured at a discrete point in the cascade flow field.

The experimental test program was conducted with the blue beam splitter (and hence blue light velocity vector component) rotated 15.667 degrees clockwise from the axial direction. It follows that the green beam splitter (and green light velocity vector component) was oriented 15.667 degrees clockwise from the tangential direction. This orientation was chosen to maximize the velocity measurement of each component.

The wind tunnel instrumentation system initiates 1,000 measurements by the signal processor for each of the blue and green beam velocity components. The experimental data returned by the signal processor is the number of cycles of a 100 MHz clock (identified in Table IV as Signal Processor Counts) which elapsed for the particle to cross eight fringe patterns. The velocity of the particle is related to signal processor counts by a constant for converting clock counts to seconds and the fringe spacing associated with either the blue or green beams. The experimental data for the blue and green velocity components are then analyzed to determine the number of occurrences for each clock count. As can be seen from Table IV, a distribution of clock counts and therefore measured velocity was obtained. This distribution is a result of flow field accelerations and/or decelerations, flow turbulence, particle dynamics, etc. Once this table of velocity distributions has been generated, the most probable blue or green velocity vector component was determined by weighting the measured velocity having the maximum number of occurrences with the two velocities immediately lower and higher than the

TABLE IV
TYPICAL SET OF EXPERIMENTAL
LASER VELOCIMETER DATA

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LASER VELOCIMETER DATA

LASER BLUE LINE			LASER GREEN LINE		
ORIENTATION(REF.AXIAL)=15.67 DEG			ORIENTATION(REF.TANG.)=15.67 DEG		
NUMBER OF MEASUREMENTS=702			NUMBER OF MEASUREMENTS=917		
SIGNAL PROCESSOR COUNTS	BLUE LINE VELOCITY (FT/SEC)	NO. OF OCCUR.	SIGNAL PROCESSOR COUNTS	GREEN LINE VELOCITY (FT/SEC)	NO. OF OCCUR.
41	1172.49	1	44	1151.87	2
43	1117.95	1	46	1101.79	1
44	1092.55	5	48	1055.88	3
45	1068.27	19	49	1034.34	12
46	1045.04	44	50	1013.65	92
47	1022.81	94	51	993.77	146
48	1001.50	134	52	974.66	133
49	981.06	101	53	956.27	139
50	961.44	78	54	938.56	78
51	942.59	44	55	921.50	78
52	924.46	32	56	905.04	61
53	907.02	33	57	889.17	34
54	890.22	18	58	873.84	33
55	874.04	24	59	859.02	22
56	858.43	15	60	844.71	22
57	843.37	19	61	830.86	13
58	828.83	10	62	817.46	10
59	814.78	13	63	804.48	14
60	801.20	10	64	791.91	11
61	788.07	7	65	779.73	13

BLUE LINE VELOCITY=998.68 FT/SEC   GREEN LINE VELOCITY=983.35 FT/SEC

LV DATA AT CASCADE INLET PLANE

PERCENT CHORD SPACING	Y (REF.LOCATION) (IN.)	AXIAL VELOCITY (FT/SEC)	TANGENTIAL VELOCITY (FT/SEC)	RESULTANT VELOCITY (FT/SEC)	FLOW DIRECTION (DEG)
58.85	1.052	696.03	1216.51	1401.55	60.22

maximum and taking the arithmetic mean. This technique of determining the most probable experimental flow velocity is required in analyzing data where accelerations, decelerations, particle dynamics, and/or other phenomena impart a significantly skewed and non-Gaussian distribution to the data. After determining the most probable blue and green velocity component, the resultant flow velocity and flow direction (referenced to axial direction) can be determined routinely.

SECTION V

DISCUSSION AND SUMMARY OF EXPERIMENTAL RESULTS

1. CASCADE PERFORMANCE RESULTS

As noted previously, the blade profile investigated in this experiment was based on the streamsurface geometry of streamline 19 of the referenced ARL rotor design. The design procedure for the subject compressor stage has been discussed in detail in Reference 1. The re-definition of the streamline geometry to yield an equivalent two-dimensional cascade has been discussed herein.

The design inlet relative Mach number for the cascade was 1.616. A part speed and an overspeed value were also investigated.

The inlet relative air angle was determined experimentally at all three relative Mach numbers. This was accomplished by examining the uniformity of the inlet flow as indicated by the upstream wave system in the schlieren image and by the static pressure measurements on the sidewall upstream of the leading edge of each blade. The cascade was run with several different inlet relative air angles at each inlet Mach number during the process of determining the correct experimental angle. At the design inlet Mach number, the experimental inlet relative air angle was approximately 1.4° greater than design. This indicates that the mass flow through the cascade is somewhat less than design. Also, the supersonic compressor cascade entrance region analysis described in Reference 3 predicted an inlet relative air angle that was in near agreement with the experimental value - with the prediction 0.353° greater than that determined experimentally. These inlet air angle results are summarized in Table V.

The cascade flow characteristics were investigated at three inlet Mach numbers, 1.535, 1.616, and 1.683. A number of sets of data were obtained over a range of static pressure ratios at each Mach number with the cone probe located 0.68 in. axially downstream. A summary of some of the common mass averaged cascade performance parameters at each inlet Mach number is shown in Table VI. The appropriate appendix for each complete data set, which includes a schlieren photograph of the cascade wave system, is also indicated. Reference should be made to the appendices for detailed listings of data and performance parameters.

TABLE VI
SUMMARY OF MASS AVERAGED PERFORMANCE PARAMETERS

P)2/P)1	MN)2	BETA)2	OMEGA	PT)2/PT)1	DF	TPLP	DEV
			MN)1 = 1.535 (APPENDIX IV)				
1.190	1.386	58.024	0.053	0.961	0.088	0.009	3.101
1.356	1.288	59.268	0.057	0.958	0.147	0.010	4.345
1.399	1.263	58.983	0.061	0.954	0.165	0.010	4.060
1.505	1.200	59.948	0.074	0.945	0.205	0.012	5.025
1.686	1.103	58.789	0.087	0.935	0.277	0.015	3.866
1.970	0.960	56.746	0.106	0.921	0.390	0.019	1.823
2.003	0.932	56.623	0.124	0.908	0.412	0.022	1.700
2.035	0.907	56.752	0.139	0.897	0.432	0.025	1.829
2.076	0.879	56.344	0.150	0.889	0.455	0.027	1.421
			MN)1 = 1.616 (APPENDIX V)				
1.220	1.454	58.656	0.049	0.963	0.085	0.008	3.733
1.468	1.315	61.204	0.061	0.953	0.162	0.010	6.281
1.672	1.209	60.875	0.074	0.943	0.231	0.012	5.952
1.870	1.112	59.157	0.089	0.932	0.301	0.015	4.234
2.036	1.031	56.408	0.106	0.919	0.365	0.019	1.485
2.097	0.996	56.113	0.119	0.908	0.392	0.022	1.137
2.220	0.922	56.892	0.151	0.884	0.446	0.027	1.969
2.300	0.891	56.839	0.149	0.885	0.470	0.027	1.916
			MN)1 = 1.683 (APPENDIX VI)				
1.119	1.575	56.907	0.060	0.953	0.058	0.011	1.984
1.356	1.438	60.399	0.069	0.945	0.120	0.011	5.476
1.543	1.331	60.372	0.092	0.927	0.183	0.015	5.449
1.751	1.229	62.019	0.106	0.916	0.243	0.016	7.096
1.982	1.118	59.832	0.128	0.899	0.321	0.021	4.909
2.230	0.997	57.209	0.159	0.874	0.412	0.028	2.286
2.274	0.984	57.018	0.155	0.878	0.422	0.028	2.095

TABLE V
EXPERIMENTAL AND DESIGN INLET RELATIVE AIR ANGLES

MN)1	DDA EXPERIMENTAL β_1	ARL DESIGN β_1	DDA ANALYTICAL PREDICTION OF REFERENCE 3
1.53	58.0		
1.616	57.25	55.85	57.603
1.683	57.25		

Figures 11, 12, and 13 show the total pressure loss coefficient, the exit air angle, and the exit Mach number as a function of static pressure ratio for inlet Mach number values of 1.535, 1.616, and 1.683, respectively. The ARL cascade design values presented in Table I have also been included in Figure 12.

Figure 12 shows that the ARL cascade design exit air angle and exit Mach number are in near agreement with the experimental data. The ARL cascade design total pressure loss coefficient, however, is seen to be substantially greater than that determined experimentally.

2. LASER VELOCIMETER RESULTS

The experimental program conducted by DDA to investigate the performance of the ARL compressor airfoil cascade included laser velocimeter (LV) measurements of the cascade interpassage flow field. Experimental LV data were obtained at the cascade design inlet Mach number. Blade to blade traverses were made across the central flow passage (passage number 3) at the cascade inlet plane, at two chordwise plane locations, and at the cascade exit plane. At each traverse plane, LV data were obtained for at least ten discrete locations to determine flow velocity and direction. These measurements were completed at two cascade static pressure ratios representative of a low and high static pressure ratio. The cascade inlet operating conditions for the LV interpassage data are presented in Table VII. The locations of the four interpassage traverse planes are shown by Figure 14. LV data obtained at these traverse planes are tabulated and presented in Tables XVII to XX, Appendix G. All LV data

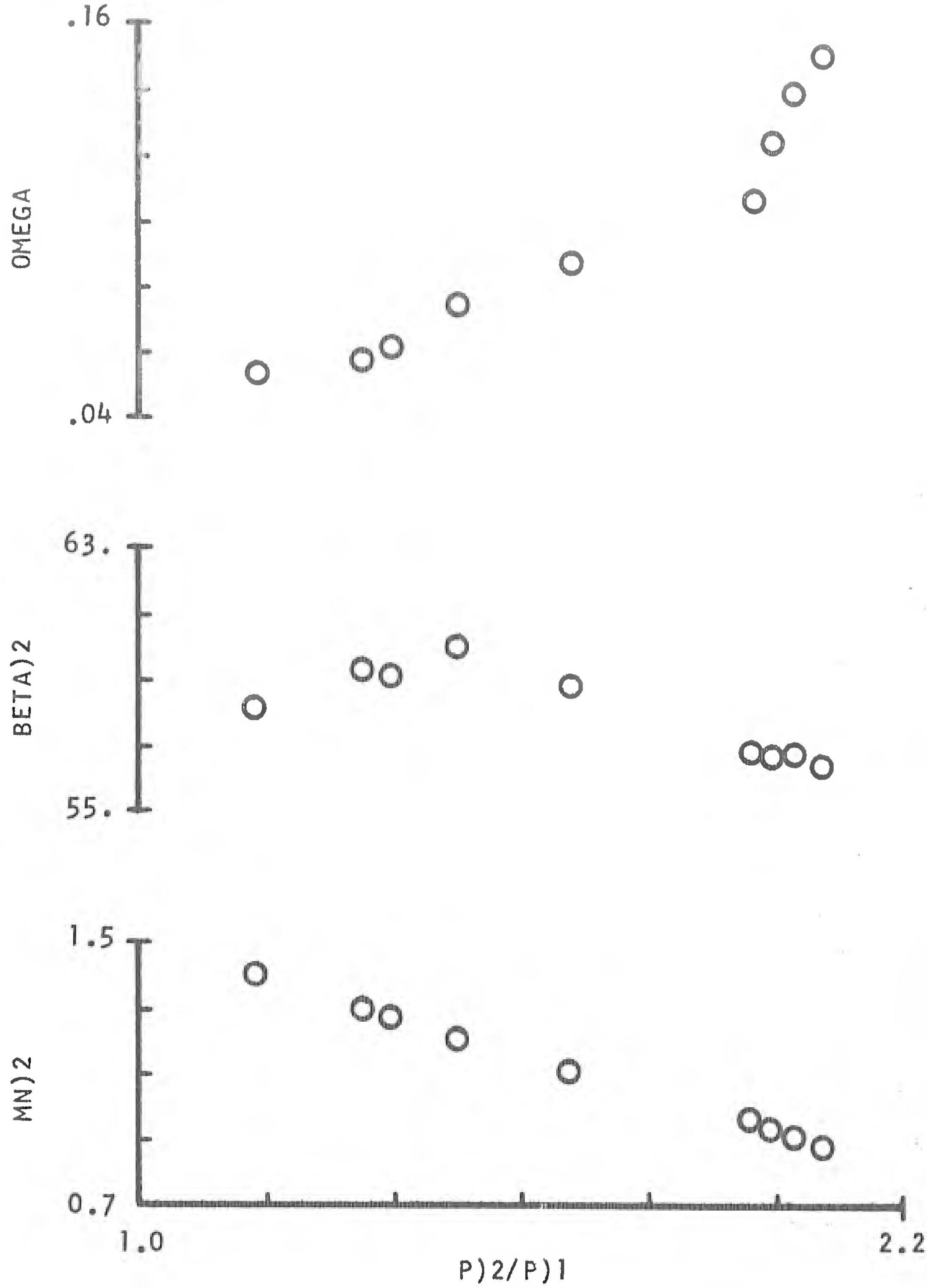


FIGURE 11. CASCADE PERFORMANCE PARAMETERS -
INLET MACH NUMBER = 1.535

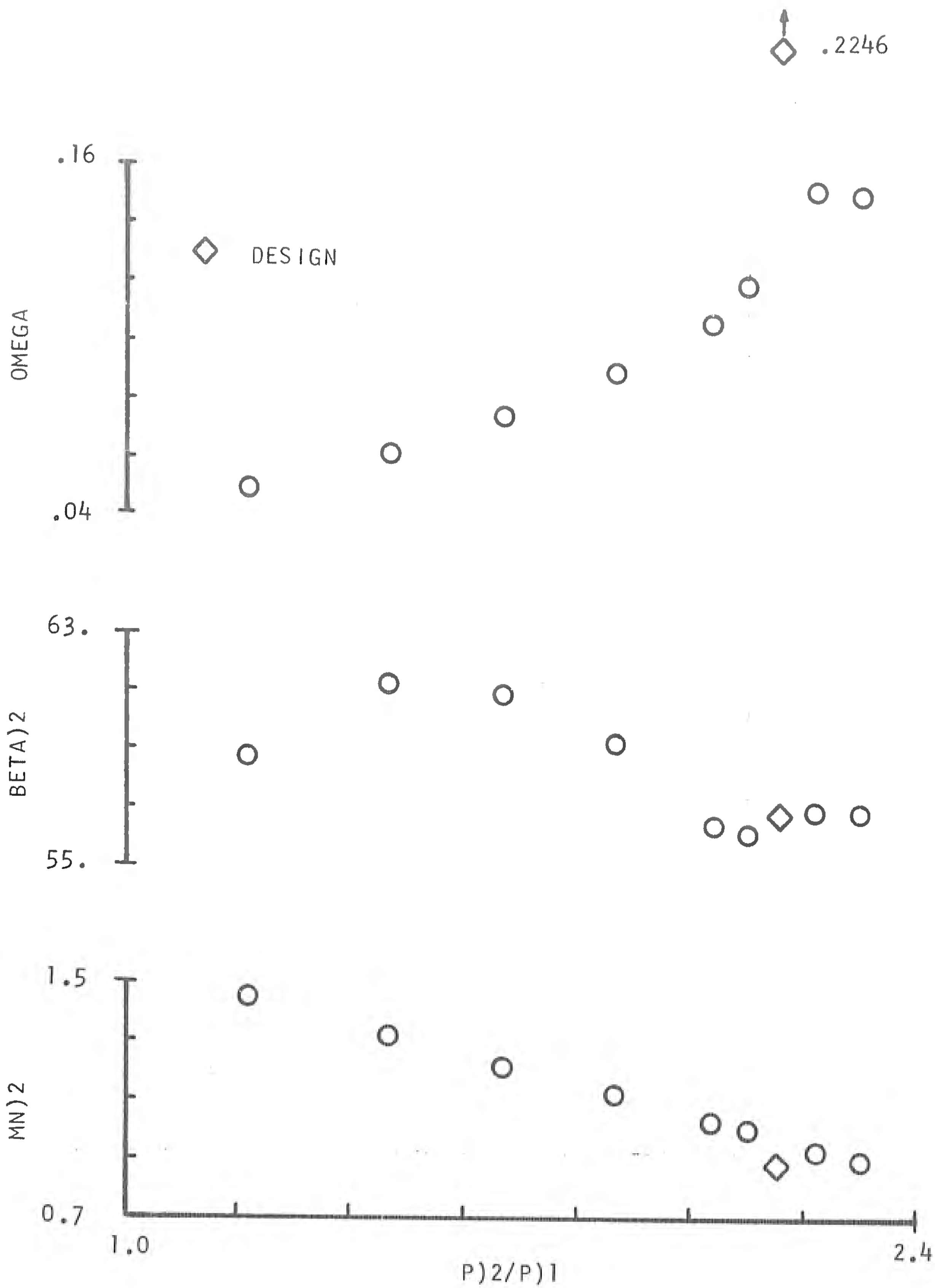


FIGURE 12. CASCADE PERFORMANCE PARAMETERS - EXPERIMENTAL AND DESIGN VALUES

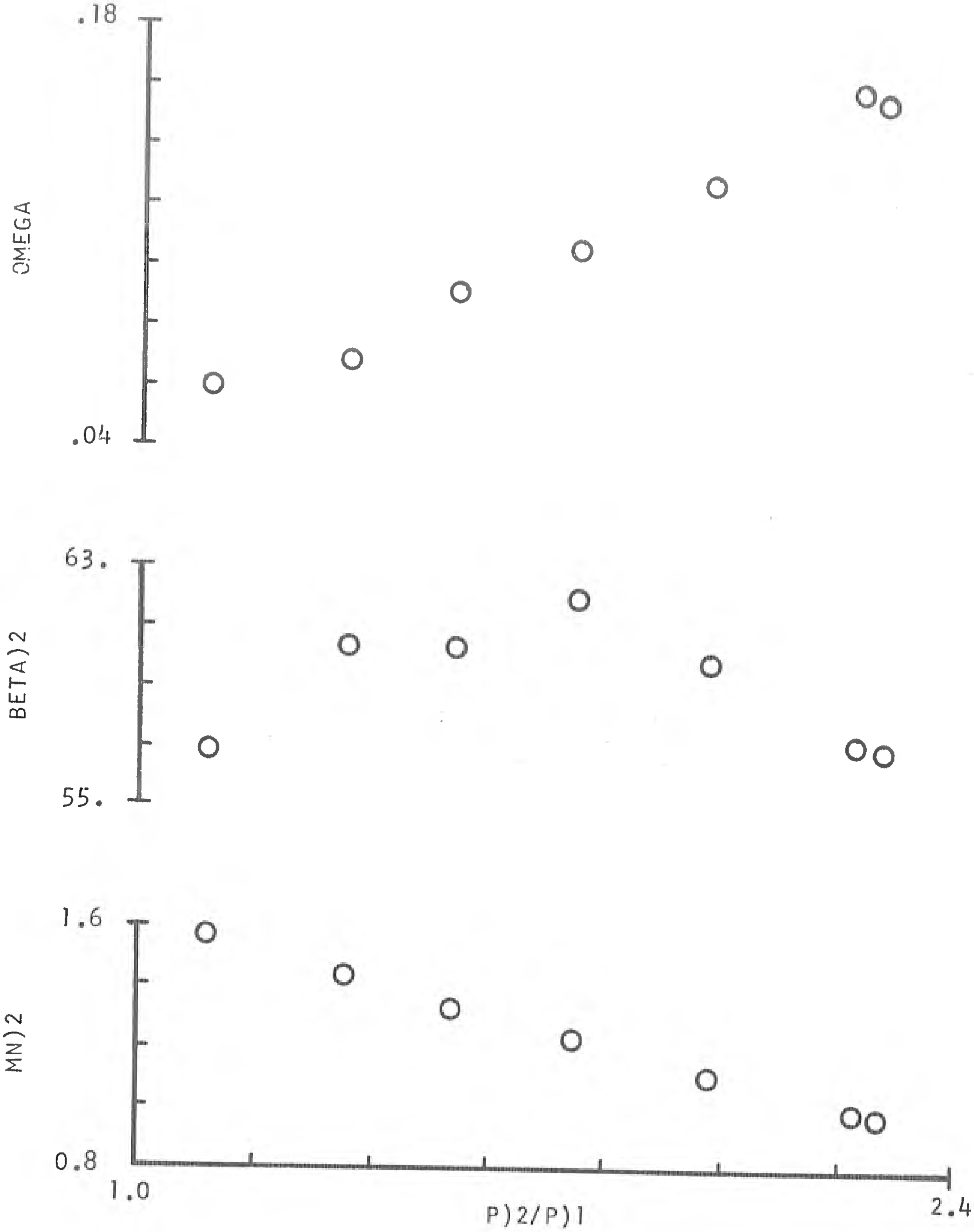
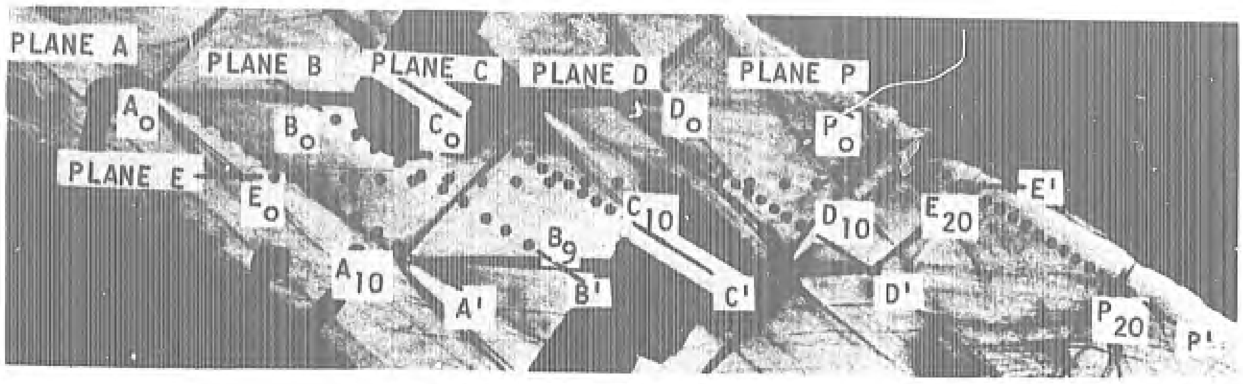


FIGURE 13. CASCADE PERFORMANCE PARAMETERS - INLET MACH NUMBER = 1.683

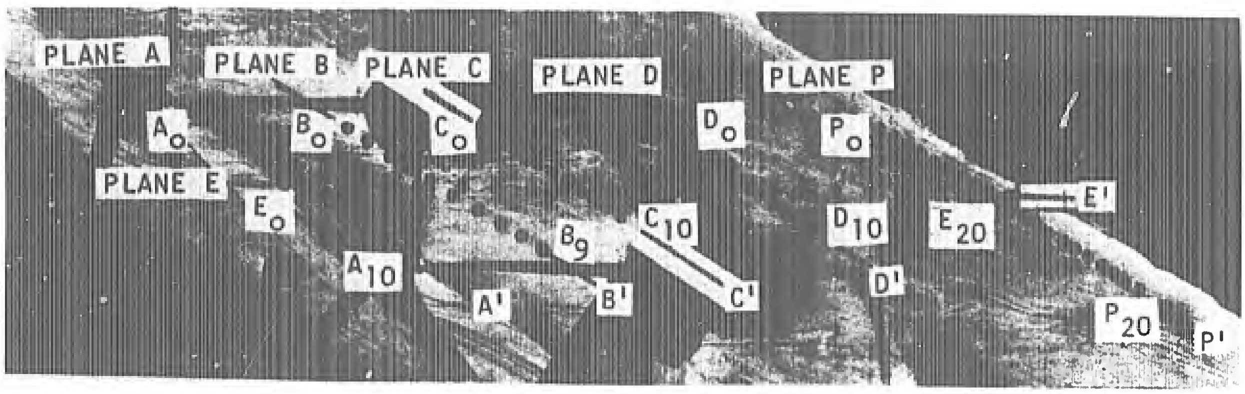
TABLE VII
CASCADE INLET OPERATING CONDITIONS FOR
LASER VELOCIMETER INTERPASSAGE DATA

	Static Pressure Ratio = 1.468	Static Pressure Ratio = 2.220
Cascade Inlet Mach No.	1.616	1.616
*Blade No. 3 Mach No.	1.591	1.340
*Blade No. 3 Velocity (Ft/Sec)	1519.6	1348.9
*Blade No. 4 Mach No.	1.639	1.360
*Blade No. 4 Velocity (Ft/Sec)	1552.2	1363.6

*Blade 3 and 4 inlet Mach number and velocity calculations were based on sidewall static pressure tap measurements. The static taps are located 0.25 inches upstream of the blade leading edge in the chordwise direction.



LOW STATIC PRESSURE RATIO



HIGH STATIC PRESSURE RATIO

311713

FIGURE 14. LASER VELOCIMETER DATA TRAVERSE PLANE IDENTIFICATION

were obtained at the passage mid-span location with 0.3 micron mean diameter alumina as a seed material.

LV data at the cascade inlet plane were obtained at eleven discrete points along traverse plane A-A' (see Figure 14). Traverse plane A-A' was located 0.0449 inch downstream of the leading edge plane in the chordwise direction (1.64% chord). The LV data at the inlet plane are summarized in Figure 15.

The second interpassage LV traverse plane (B-B') was located 0.846 inch downstream of the leading edge plane in the chordwise direction (30.95% chord). Measurements were obtained at ten discrete points and are summarized in Figure 16.

The third LV traverse plane (C-C') was located 1.651 inches downstream of the leading edge plane (60.4% chord) as shown in Figure 14. LV measurements were obtained at eleven discrete points and are summarized by Figure 17.

LV data at the cascade exit plane were obtained at eleven discrete points along traverse plane D-D'. Traverse plane D-D' was located 2.688 inches downstream of the leading edge plane in the chordwise direction (98.4% chord). The LV data at the exit plane are summarized in Figure 18.

The LV data at the cascade inlet plane and second traverse plane B-B' were obtained across 80 to 85% of the passage spacing. At the third traverse plane C-C' and the cascade exit plane, LV data were restricted to approximately 50% of the passage spacing due to blockage of the LV signals by the blade trunnions for the optical setup being employed.

Additional LV experimental data were acquired from the ARL cascade as a part of the DDA Independent Research and Development Program (1975 IR & D Project No. 519) and are presented herein. Two additional traverses were completed as a part of the IR & D program. One traverse consisting of 21 discrete points at two static pressure ratios was made along the centerline of cascade passage No. 3 as shown in Figure 14. The data for these traverses are tabulated in Tables XXI and XXII, Appendix H, and are summarized in Figure 19.

The second LV traverse was completed along the cone probe traversing plane (Plane P-P' in Figure 14). LV data and cone probe data consisting of 21 points at two static pressure ratios are tabulated in Tables XXIII and XXIV, Appendix H. Comparisons of the LV and cone probe data are shown graphically in Figures 20 and 21.

A cursory analysis of the LV data has been completed to permit comparisons with the cone probe performance data. The results are presented in Table VIII.

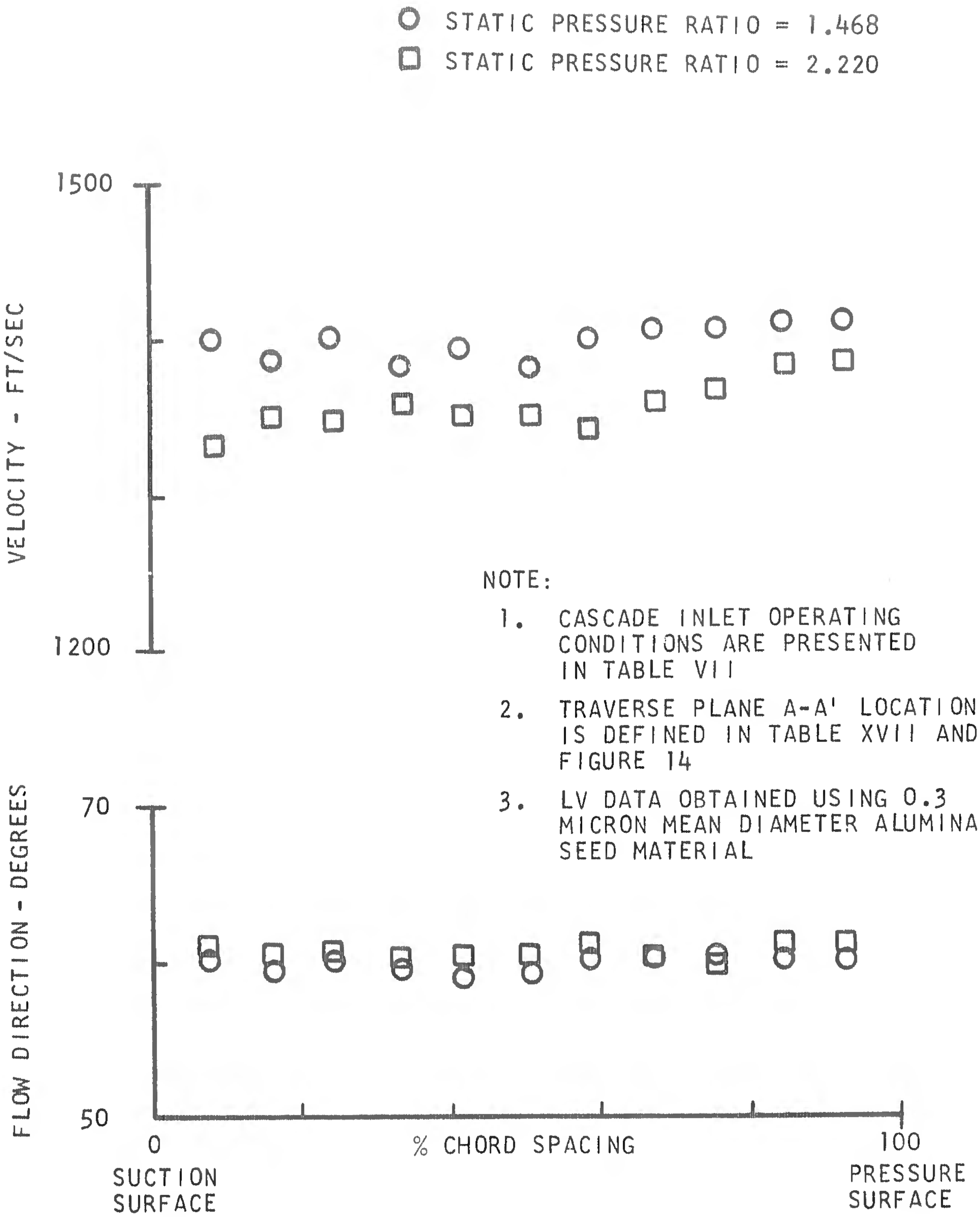


FIGURE 15. LASER VELOCIMETER DATA FOR TRAVERSE PLANE A-A'

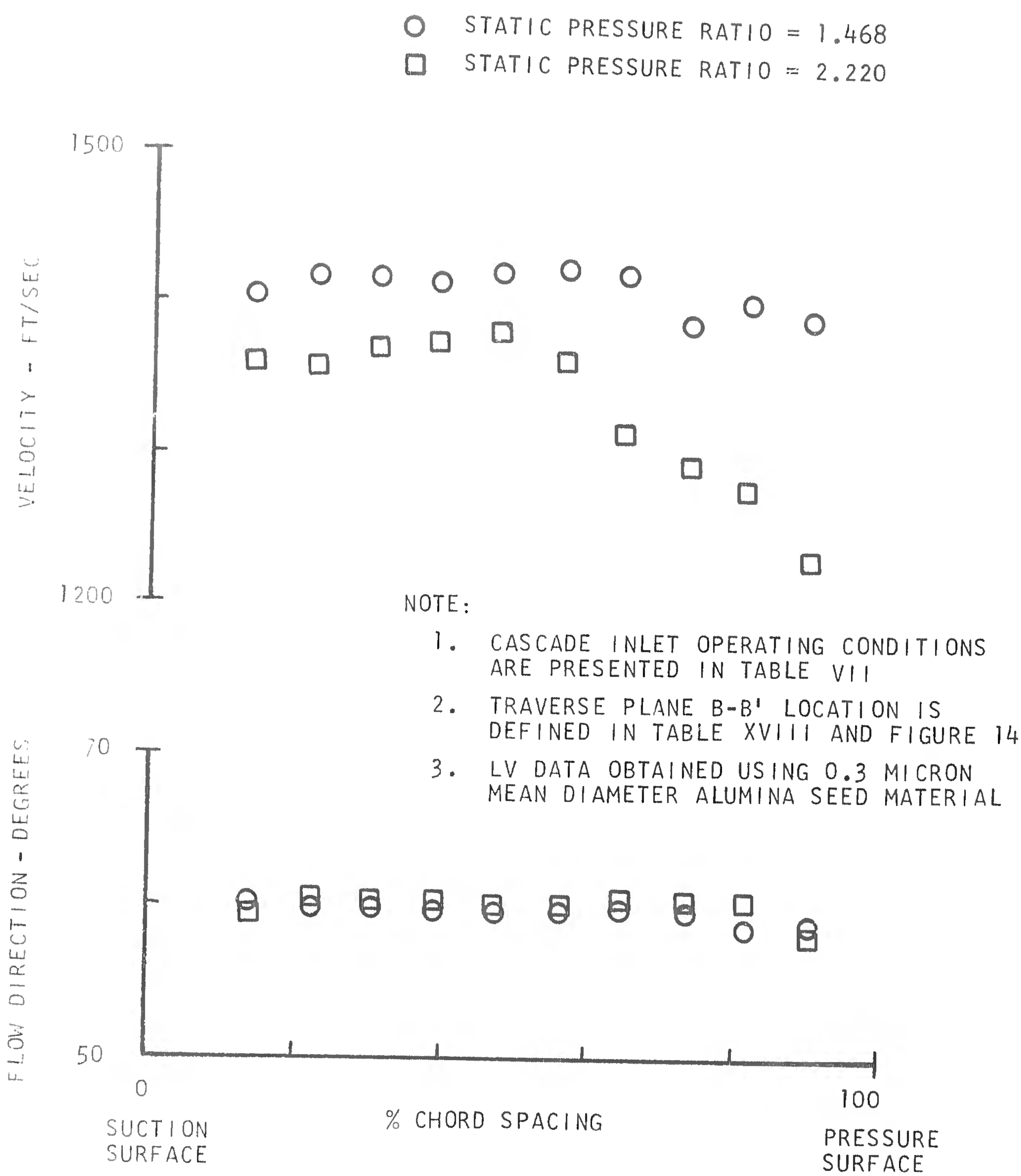


FIGURE 16. LASER VELOCIMETER DATA FOR TRAVERSE PLANE B-B'

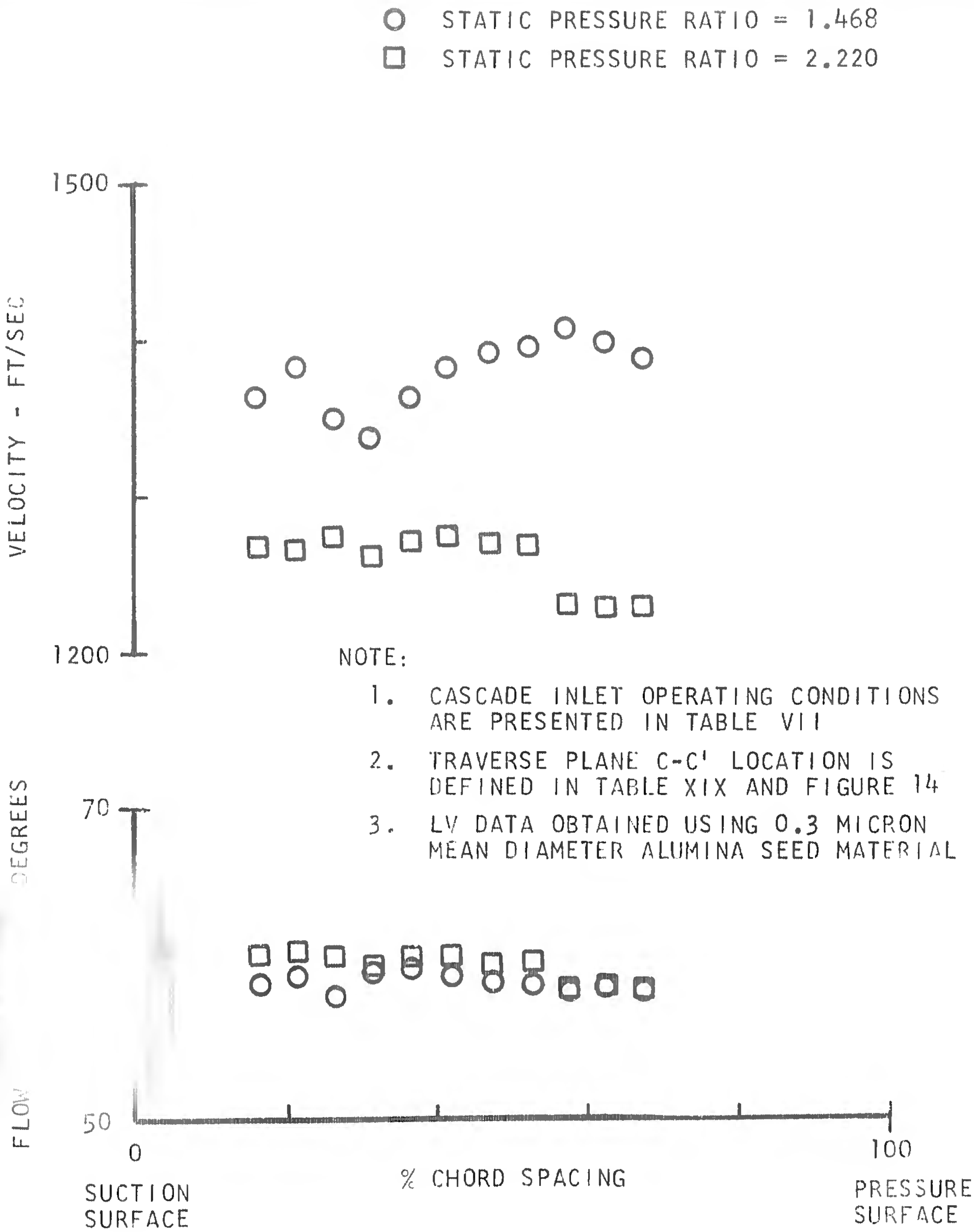


FIGURE 17. LASER VELOCIMETER DATA FOR TRAVERSE PLANE C-C'

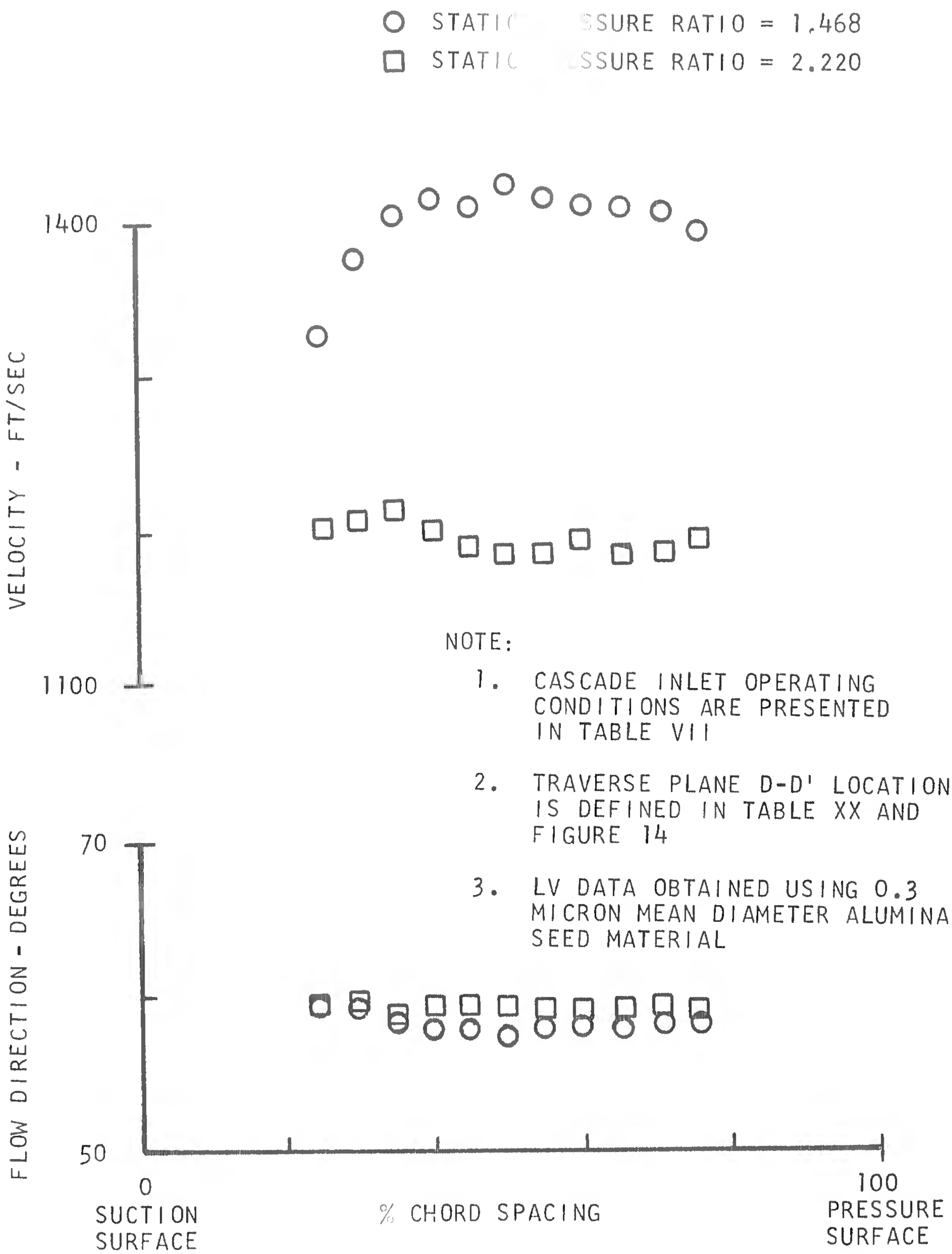


FIGURE 18. LASER VELOCIMETER DATA FOR TRAVERSE PLANE D-D'

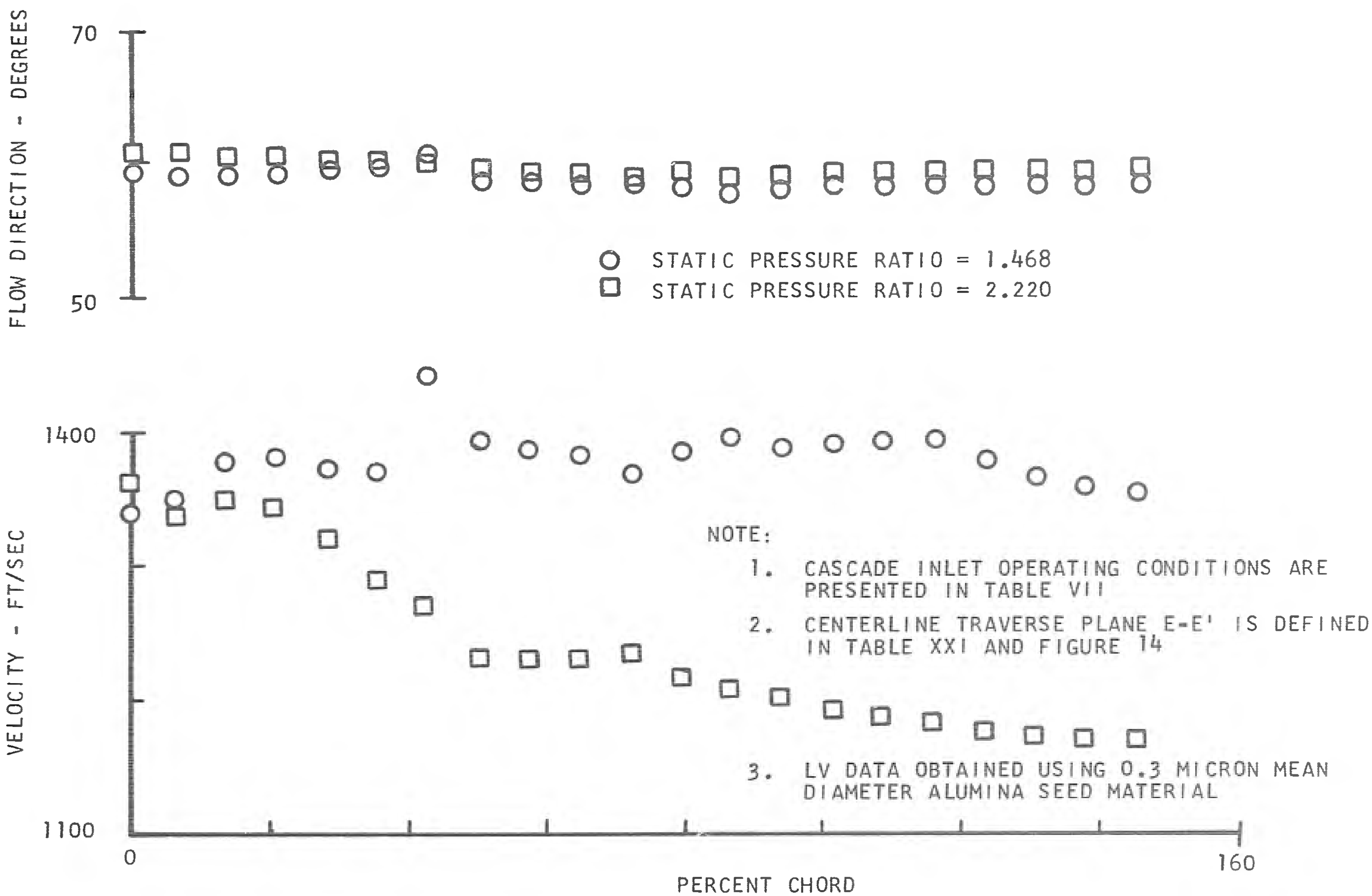


FIGURE 19. LASER VELOCIMETER DATA FOR TRAVERSE ALONG CENTERLINE OF BLADE PASSAGE NO. 3

INLET MACH NO. = 1.616

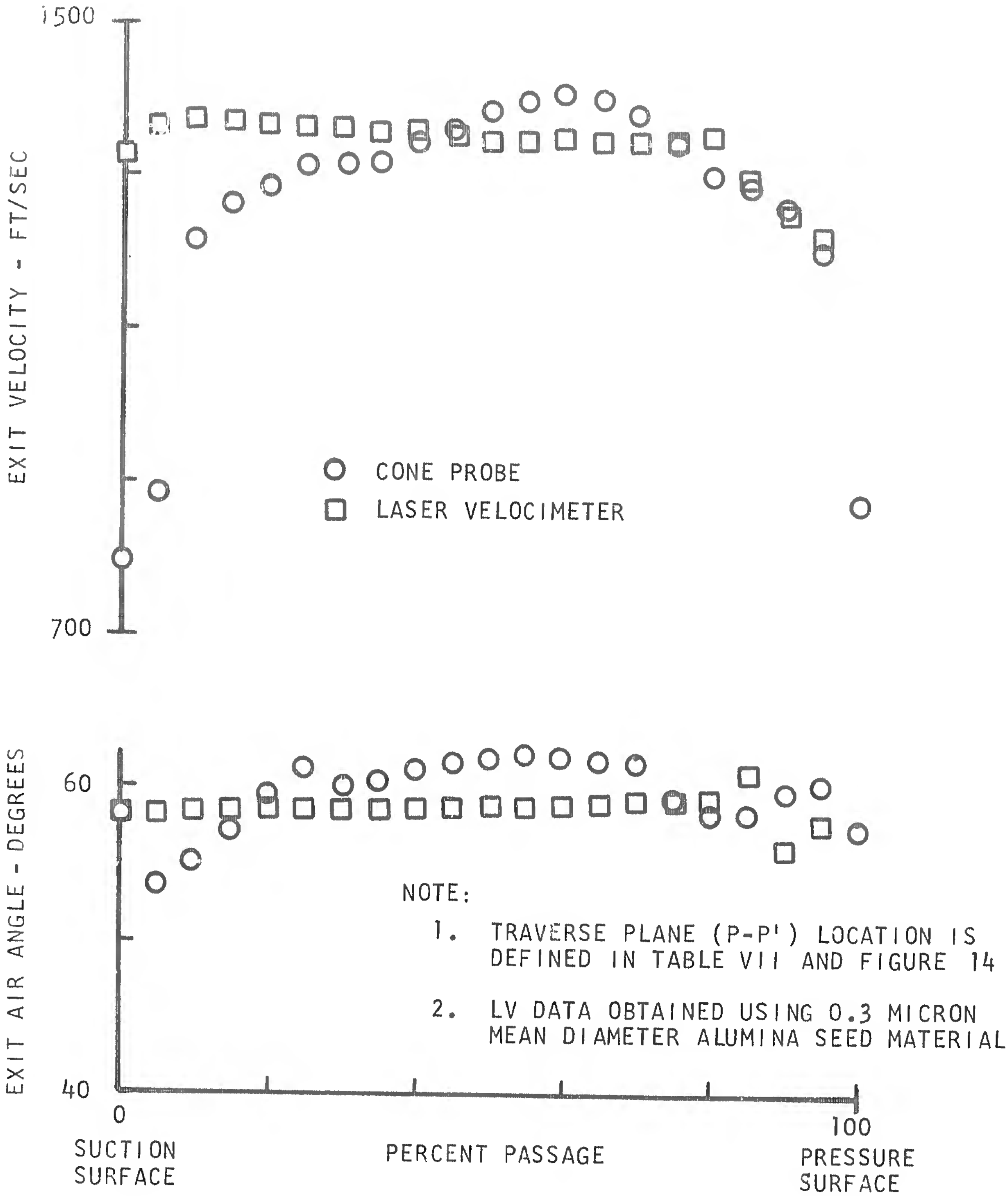


FIGURE 20. CONE PROBE AND LASER VELOCIMETER DATA COMPARISON - STATIC PRESSURE RATIO = 1.564

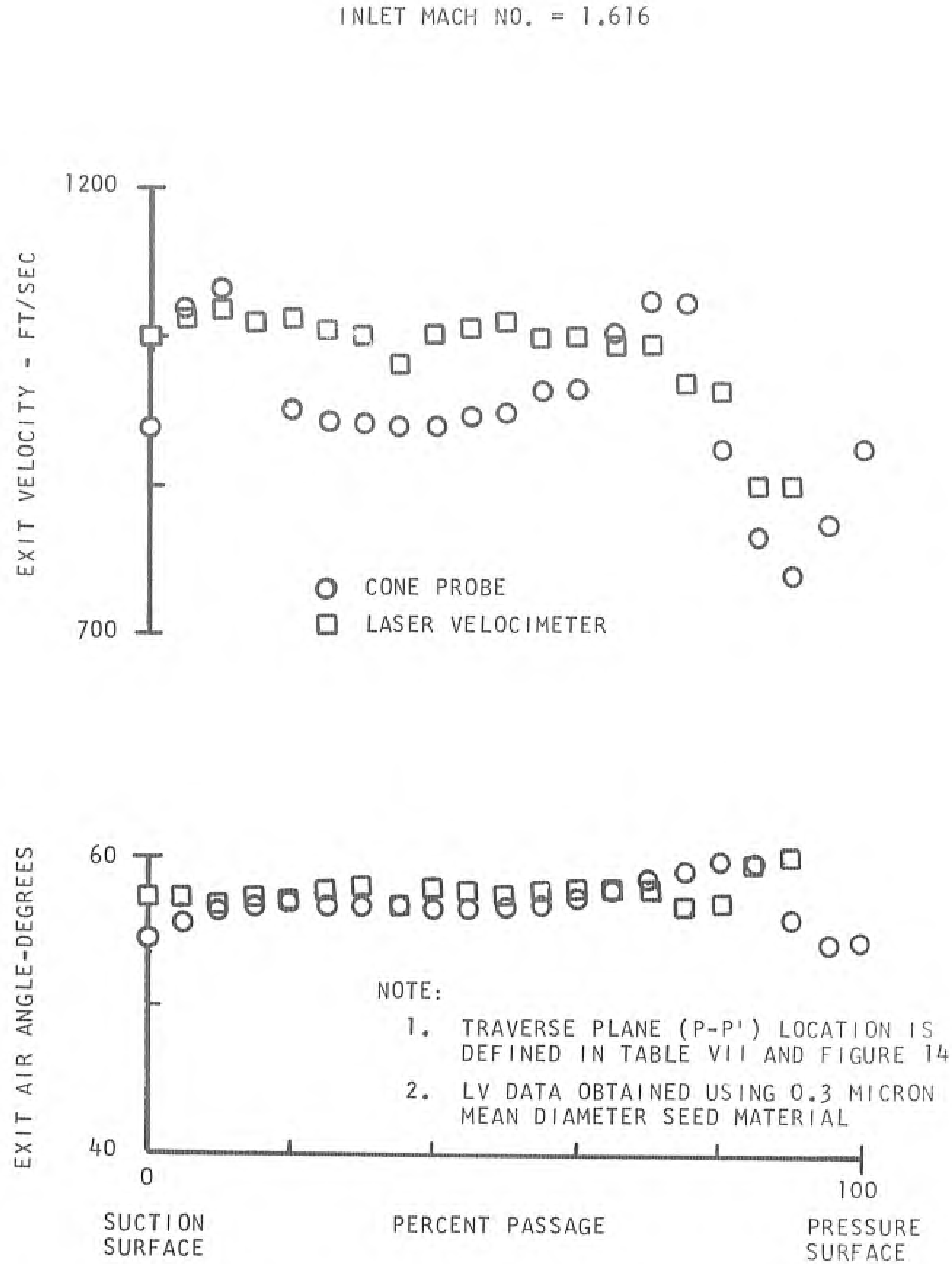


FIGURE 21. CONE PROBE AND LASER VELOCIMETER DATA COMPARISON - STATIC PRESSURE RATIO = 2.226

TABLE VIII
COMPARISON OF LASER VELOCIMETER* AND CONE PROBE PASSAGE FLOW PARAMETERS

	STATIC PRESSURE RATIO = 1.564	STATIC PRESSURE RATIO = 2.226
MASS FLOW-LB/SEC PER INCH SPAN		
INLET PLANE A-A' (REF. FIGURE		
• LASER VELOCIMETER**	0.288	0.352
EXIT PLANE P-P'		
• LASER VELOCIMETER	0.359	0.371
• CONE PROBE	0.328	0.363
EXIT FLOW DIRECTION (PLANE P-P')-DEGREES (MASS-AVERAGED)		
• LASER VELOCIMETER	58.7	57.9
• CONE PROBE	59.6	57.0

*Assumptions for LV calculations:

1. Total conditions constant through inlet plane
2. Linear density distribution from blade chord to blade chord along inlet plane based on the first blade surface static pressure taps.
3. Zero thickness blade in the inlet plane with inviscid flow
4. Cone probe determined density used in LV calculations at exit plane

**LV mass flows at the inlet plane are based on low and high static pressure ratios of 1.468 and 2.220, respectively.

SECTION VI

CONCLUSIONS

- A cascade of blades with a profile based on the stream-surface of streamline 19 of an ARL axial compressor stage was tested in a supersonic wind tunnel. The results of the test were in essential agreement with the design.

- At the design inlet relative Mach number of 1.616, this cascade was able to maintain a static pressure ratio of over 2.2. The losses were relatively low with ω approximately 0.15 at a static pressure ratio of 2.2.

- The cascade included six blades, linear sidewalls with sidewall bleed. The flow characteristics of the cascade were good and the data were very consistent.

- Laser velocimeter blade-to-blade traverses were made at the design Mach number across the central flow passage at the cascade inlet plane, at two passage planes, and at the cascade exit plane for two static pressure ratios. These LV data were trendwise in agreement with schlieren photographs of the cascade flow field.

- Laser velocimeter traverses were made at the same location as the cone probe and also at mid-spacing in the chordwise direction at the design Mach number for two static pressure ratios as part of the DDA Independent Research and Development Program. Favorable comparison was obtained between the cone probe and the laser velocimeter data.

APPENDIX A

ARL REDEFINITION OF STREAMLINE 19

It was presumed that the highest degree of equivalency would be retained if the basic design procedure used to accomplish the original design was duplicated to the maximum extent possible. The original design was accomplished by fitting airfoils of arbitrary geometry to relative flow angles defined by an axisymmetric flow-field analysis employing computing stations within as well as external to blade rows. In this analysis, the work distributions from leading to trailing edge along each streamsurface within the rotor were specified as input data to the design procedure. Meridional distributions of deviation angle, blockage, and relative total pressure loss were assumed. Optimization of the work distribution within the rotor was based upon a preconceived notion of what constituted a desirable axisymmetric static pressure distribution between leading and trailing edge along each streamsurface. Following this design philosophy, the two-dimensional equivalent airfoil was established by performing an identical design procedure. The major steps involved in converting from the original three-dimensional rotor blade to an equivalent two-dimensional cascade airfoil were as follows.

First, to check the validity of using a reduced number of streamlines, the axisymmetric design program was rerun by using input data for only streamlines 18, 19, 20 of the original rotor design. For this case streamline 18 corresponded to the hub and streamline 20 to the case. The annulus flow rate was recomputed for the corresponding streamtubes, and the annulus wall boundary layer blockages were also adjusted for the reduced flow area. Values obtained with this approach were in agreement with the original design results for streamlines 18, 19, and 20.

To achieve two-dimensional results, the three streamline approach was taken by utilizing a blade of 1.0 inch span which was assumed to be located within a cylindrical annulus having an inner radius of 10,000 inches. Centrifugal gradients within the annulus were thereby rendered negligible. A meridional blade chord of 10.0 inches was selected for convenience and ease of interpreting results normalized to unity. In addition to respecifying the basic blade dimensions, the following changes were made to the design program input based on the DDA conditions and the streamline 19 data of the final rotor design.

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1. Based on an average radius of 8.16 inches (streamline 19), an incidence angle of 3.77° was obtained from the incidence angle input data of the quasi-three-dimensional analysis.

2. The meridional work distribution was specified as a function of the absolute whirl velocity distribution at each computing station. For the DDA inlet conditions and $W\theta_2/W\theta_1 = 0.6349$, a value of 503.811 ft/sec was calculated for the two-dimensional $W\theta_2$ value. The three-dimensional whirl velocity distribution for the internal blade computing stations was then scaled with a $W\theta_2$ (2-dimensional)/$W\theta_2$ (3-dimensional) ratio of 0.8556 to achieve the two-dimensional input values. This distribution is shown in Figure 22. It was found that the above adjustment was sufficient to yield a satisfactory static pressure match between the two- and three-dimensional final values. A comparison of these values can be seen in Figure 23.

3. The loss coefficient for the three-dimensional analysis was varied linearly from a leading edge value of zerc to a trailing edge value of 0.2338. In a like manner, the loss coefficient for the two-dimensional case was varied from zero at the leading edge to a final value of 0.2246 at the trailing edge (DDA value).

4. The initial input values of blade blockage to the two-dimensional analysis were the final values obtained from the three-dimensional results. However, the final two-dimensional values were adjusted to be consistent with the revised airfoil geometry.

5. The two-dimensional input value for the total number of blades was initially calculated for the three-dimensional blade spacing and the ratio of 3D/2D chord length. During the iterative design procedure, this value was updated for the three-dimensional solidity and the calculated two-dimensional true chord length.

6. An adjusted mass flow rate and blade RPM were calculated for the two-dimensional analysis. The flow rate was based on the DDA inlet conditions and the geometry of the two-dimensional cylindrical annulus at the 10,000-inch inner radius. Blade RPM was based on the calculated two-dimensional blade speed, again for DDA inlet conditions.

In addition to the above changes to the input data, the annulus wall boundary layer blockage values were set equal to zero for the two-dimensional analysis. The three-dimensional deviation distribution was adopted without change for

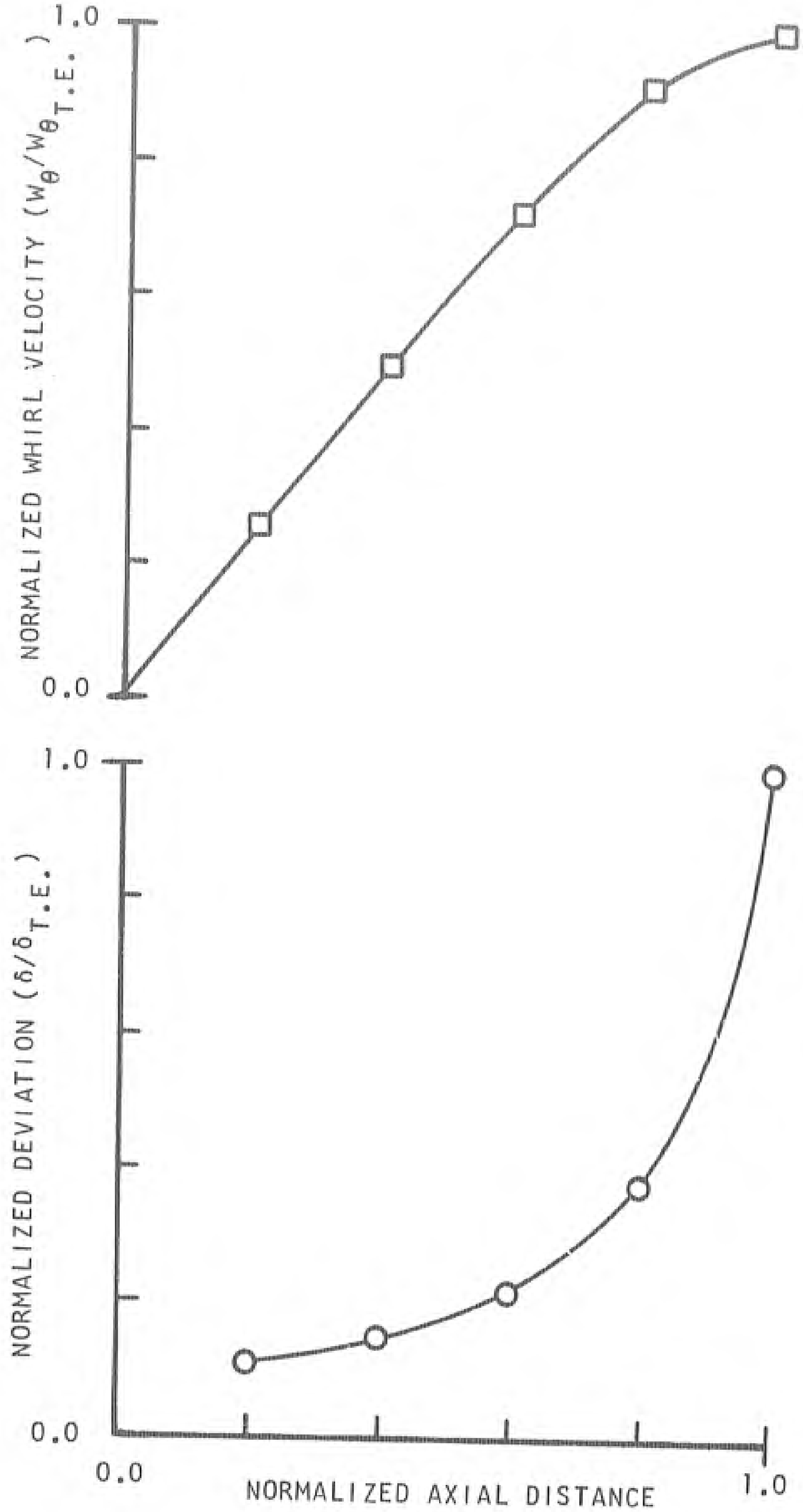

FIGURE 22. NORMALIZED DEVIATION AND NORMALIZED WHIRL VELOCITY VS. NORMALIZED AXIAL DISTANCE

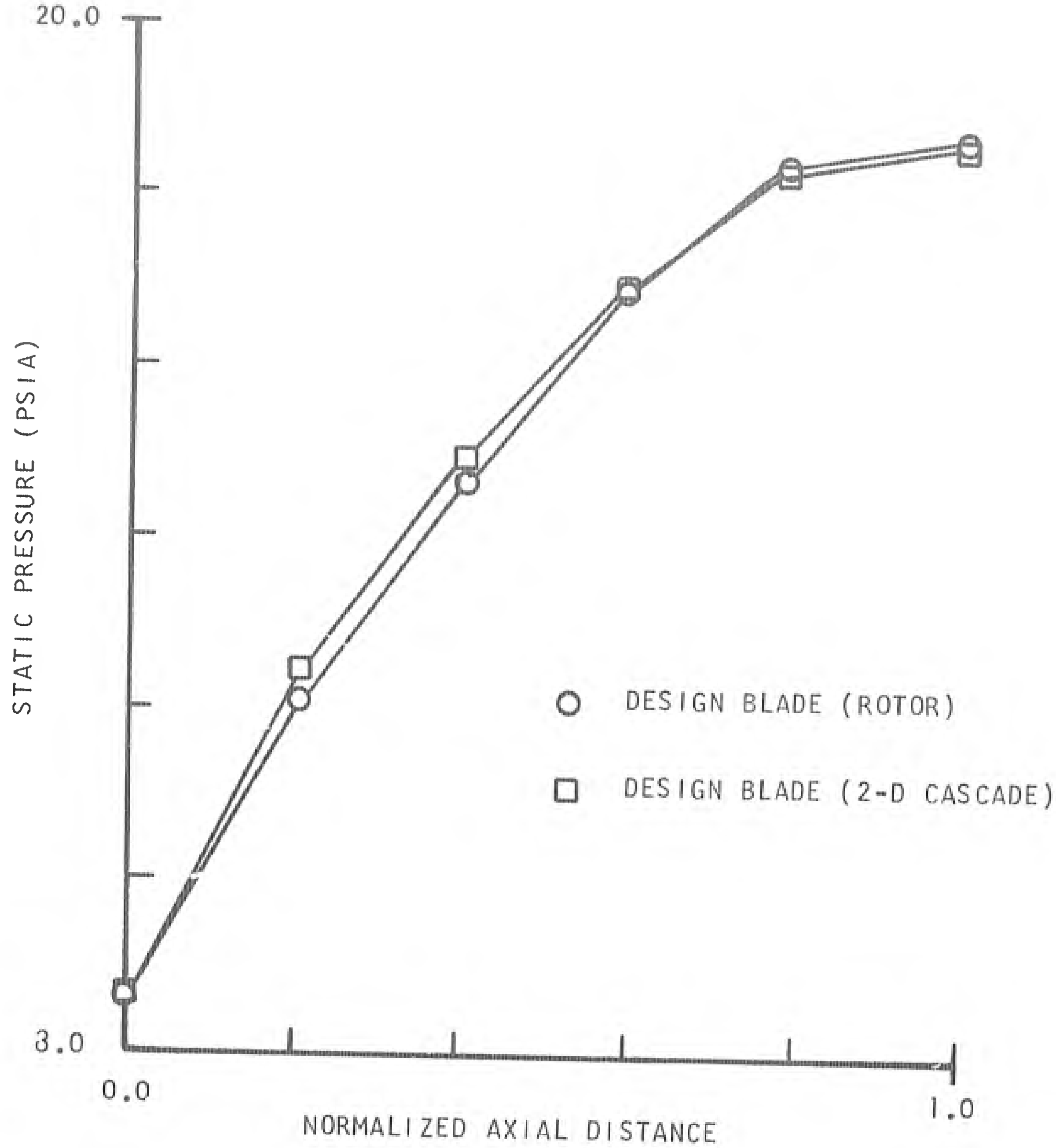

FIGURE 23. CALCULATED STATIC PRESSURE DISTRIBUTION COMPARISON

the two-dimensional analysis. A normalized plot of this distribution is shown in Figure 22. The axisymmetric flow field analysis was accomplished according to the "streamline curvature" calculation technique using the computer program described in Reference 4. The original arbitrary airfoils were defined according to Reference 5. However, during this two-dimensional redesign, the computer program of Reference 5 proved incapable of finding an arbitrary camber line with less than two inflection points — a condition judged undesirable. Consequently, this program was modified in the manner described in Reference 4. The modified method of obtaining an arbitrary camber line, when checked against the original design, produced an airfoil virtually indistinguishable from the original. However, when used to determine the revised airfoil, it managed to produce a camber line having the desired single inflection point.

APPENDIX B

PERFORMANCE DATA REDUCTION EQUATIONS

This appendix presents the data reduction procedures which are incorporated in the DDA wind tunnel on-line instrumentation system to analyze experimental data from supersonic compressor cascades. Figure 24 presents a sketch of the cascade flow field.

NOZZLE EXIT CONDITIONS

The DDA supersonic wind tunnel utilizes fixed converging-diverging nozzles to provide a supersonic flow field to the wind tunnel test section. The design Mach number of the fixed supersonic nozzles (Mn_0) has been experimentally verified in nozzle calibration studies. The wind tunnel total pressure (P_T) or nozzle exit total pressure is measured in a low velocity stagnation plenum with a total pressure probe. Likewise, the wind tunnel total temperature (T_{T_0}) or nozzle exit total temperature is measured in a low velocity stagnation plenum with a total temperature probe.

CASCADE INLET CONDITIONS

The cascade inlet flow field is established by a sharp leading edge wedge which is positioned upstream of the first blade in the cascade. The cascade inlet flow direction is determined by the orientation of the wedge with respect to the airfoils. The cascade inlet Mach number is determined by the orientation of the wedge with respect to the nozzle exit flow field. The inlet Mach number is established by either expanding or compressing (shocking) the nozzle flow about the wedge. This is accomplished by rotating the test section with respect to the nozzle. The boundary layer thickness on the wedge has been established experimentally and is taken into account when positioning the wedge with respect to the airfoils.

The degrees of expansion or compression of the nozzle flow field (Δ) is determined by

$$\Delta = \theta_W - (90° - \theta_{TS})$$

The wedge angle (θ_W) is defined as the angle between axial direction and the wedge surface, including boundary layer thickness. The test section angle (θ_{TS}) is defined as the angle between tangential direction and the wind tunnel axis (horizontal). By definition, if delta (Δ) is positive, the nozzle exit flow field will undergo an oblique shock, and the resulting cascade inlet flow field properties are obtained from the governing oblique shock relations. If delta is negative, the nozzle flow field will undergo a Prandtl-Meyer expansion from which the inlet properties are determined.

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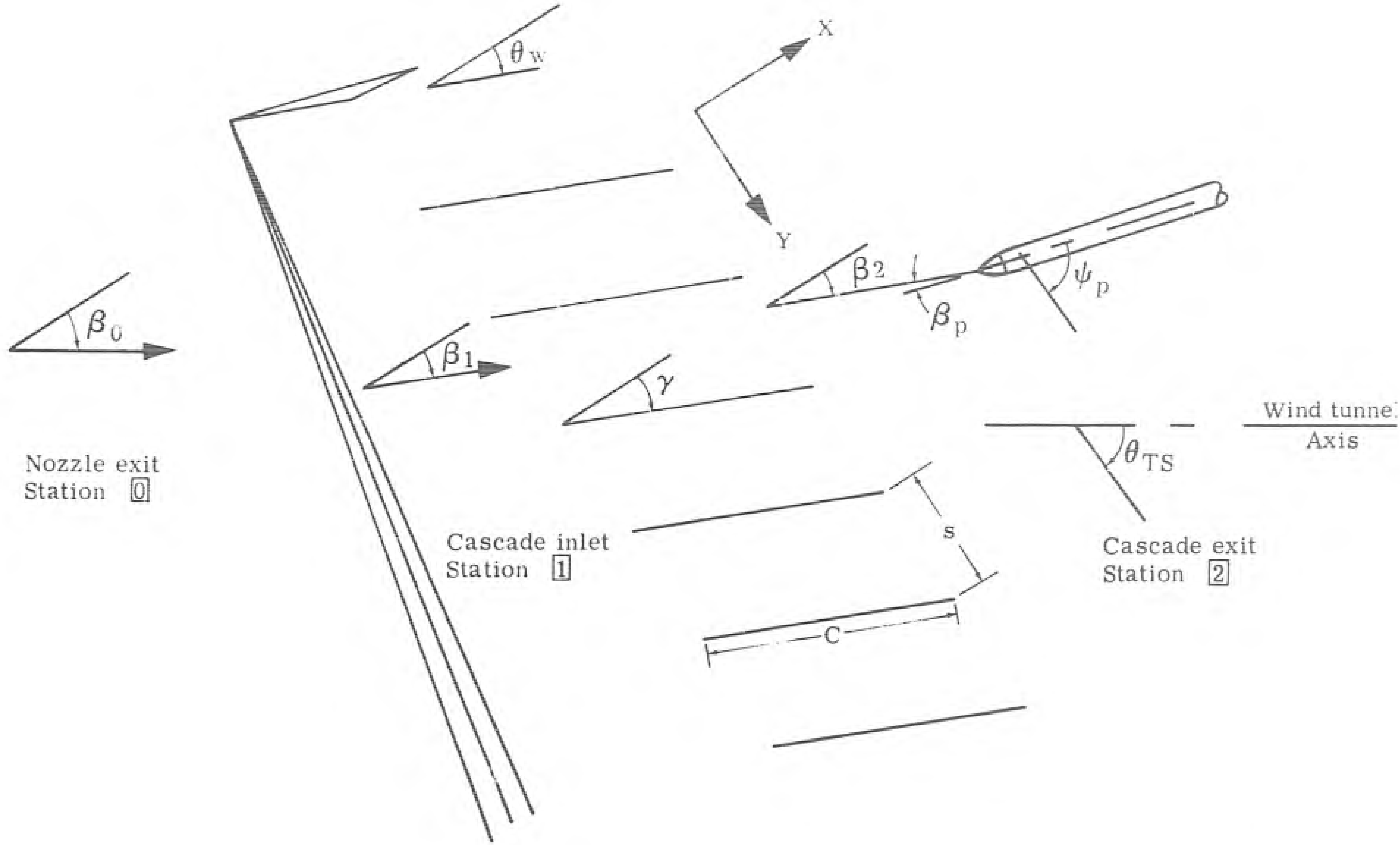

FIGURE 24. SCHEMATIC OF SUPERSONIC COMPRESSOR CASCADE FLOW FIELD

Employing the governing equations, which are discussed in Reference 6, for either expansion or compression, one can establish the cascade inlet Mach number (Mn_1) based on delta. If the flow undergoes an oblique shock, the loss in total pressure across the shock is also calculated to determine the cascade inlet total pressure (P_{T_1}). The cascade inlet flow direction (β_1) is set equal to the wedge angle. The inlet total temperature (T_{T_1}) is assumed to be equal to the tunnel total temperature.

Additional cascade inlet flow field parameters are calculated as follows:

Inlet static pressure P_1

$$P_1 = \frac{P_{T_1}}{\left[1 + \frac{k-1}{2} Mn_1^2\right]^{\frac{k}{k-1}}}$$

Inlet axial Mach number Mn_{X_1}

$$Mn_{X_1} = Mn_1 \cos\beta_1$$

Inlet tangential Mach number Mn_{Y_1}

$$Mn_{Y_1} = Mn_1 \sin\beta_1$$

Inlet total to static temperature ratio $\frac{T_{T_1}}{T_1}$

$$\frac{T_{T_1}}{T_1} = 1 + \frac{k-1}{2} Mn_1^2$$

Inlet total to static pressure ratio $\frac{P_{T_1}}{P_1}$

$$\frac{P_{T_1}}{P_1} = \left[1 + \frac{k-1}{2} Mn_1^2\right]^{\frac{k}{k-1}}$$

Inlet mass flow rate per passage per inch span m_1

$$m_1 = P_1 Mn_{X_1} \sqrt{\frac{kg}{RT_{T_1}}} \sqrt{\frac{T_{T_1}}{T_1}} \quad s$$

For $k = 1.4$, $g = 32.175$ ft/sec^2, $R = 53.34 \frac{\text{ft-lb}}{\text{lb-}^\circ\text{R}}$

$$m_1 = .91896 \frac{P_1 Mn_{X_1}}{\sqrt{T_{T_1}}} \sqrt{\frac{T_{T_1}}{T_1}} \quad s$$

Inlet dynamic pressure Q_1

$$Q_1 = \frac{1}{2} k P_1 Mn_1^2$$

Inlet Reynolds number N_{R_1}

$$N_{R_1} = \frac{12 P_1 Mn_1 \sqrt{\frac{kg}{RT_{T_1}}} \sqrt{\frac{T_{T_1}}{T_1}} \quad c}{\mu_1}$$

Suction surface incidence i_{ss}

$$i_{ss} = \beta_1 - \kappa_{ss}$$

Mean line incidence i_{ML}

$$i_{ML} = \beta_1 - \kappa_{ML}$$

CASCADE IDEAL PERFORMANCE

The cascade ideal performance calculations employ sidewall static pressure taps at the cascade exit to assess the uniformity of the flow field and relate exit to inlet flow properties to establish the test condition.

Mean exit sidewall static pressure P_{2_A}

$$P_{2_A} = \sum_{i=1}^{n} \frac{P_i}{n}$$

where

P_i = Sidewall static pressure,

n = Number of sidewall static taps

RMS deviation of sidewall static taps RMS

$$RMS = \sqrt{\sum_{i=1}^{n} \frac{(P_{2_A} - P_i)^2}{n}}$$

where

P_i = Sidewall static pressure

n = Number of sidewall static taps

Ideal exit Mach number $Mn_{2_{ID}}$

$$Mn_{2_{ID}} = \left[\frac{2}{k-1} \left\{\left(\frac{P_{T_1}}{P_{2_A}}\right)^{\frac{k-1}{k}} -1\right\}\right]^{\frac{1}{2}}$$

Ideal static pressure ratio $P_{R_{ID}}$

$$P_{R_{ID}} = \frac{P_{2_A}}{P_1}$$

INSTRUMENTED BLADE PARAMETERS

Local static pressure rise parameter S

$$S = \frac{P_L - P_1}{Q_1}$$

where

P_L = local surface static pressure, PSIA

Local surface pressure ratio $\frac{P_L}{P_T}$

$$\frac{P_L}{P_T} = \frac{P_L}{P_{T_1}}$$

Surface static pressure tap location $\% C_i$

Referring to Figure 25, one can determine the location of the blade surface static pressure taps on either the pressure or suction surface as follows:

$$\alpha_i = \tan^{-1} \left(\frac{Y_i}{X_i}\right)$$

$$\% C_i = \frac{\cos(\alpha_i - \gamma) \sqrt{X_i^2 + Y_i^2}}{C} \quad (100)$$

BLADE FORCES AND MOMENTS

Figure 26 shows the coordinate system used for the identification of the surface static pressure taps along with the nomenclature and assumed directions for the calculations. Calculation of the blade forces due to the surface static pressure distribution can be completed systematically over the blade surface between the first and last static pressure taps. Treatment of that portion of the blade surface between the leading edge and first static pressure, as well as the surface between the last static tap and the trailing edge, depends on either estimation of the pressure distribution on those surfaces or certain simplifying assumptions with regard to the leading and trailing edge pressures. This report assumes that at the leading edge, the pressure on the pressure

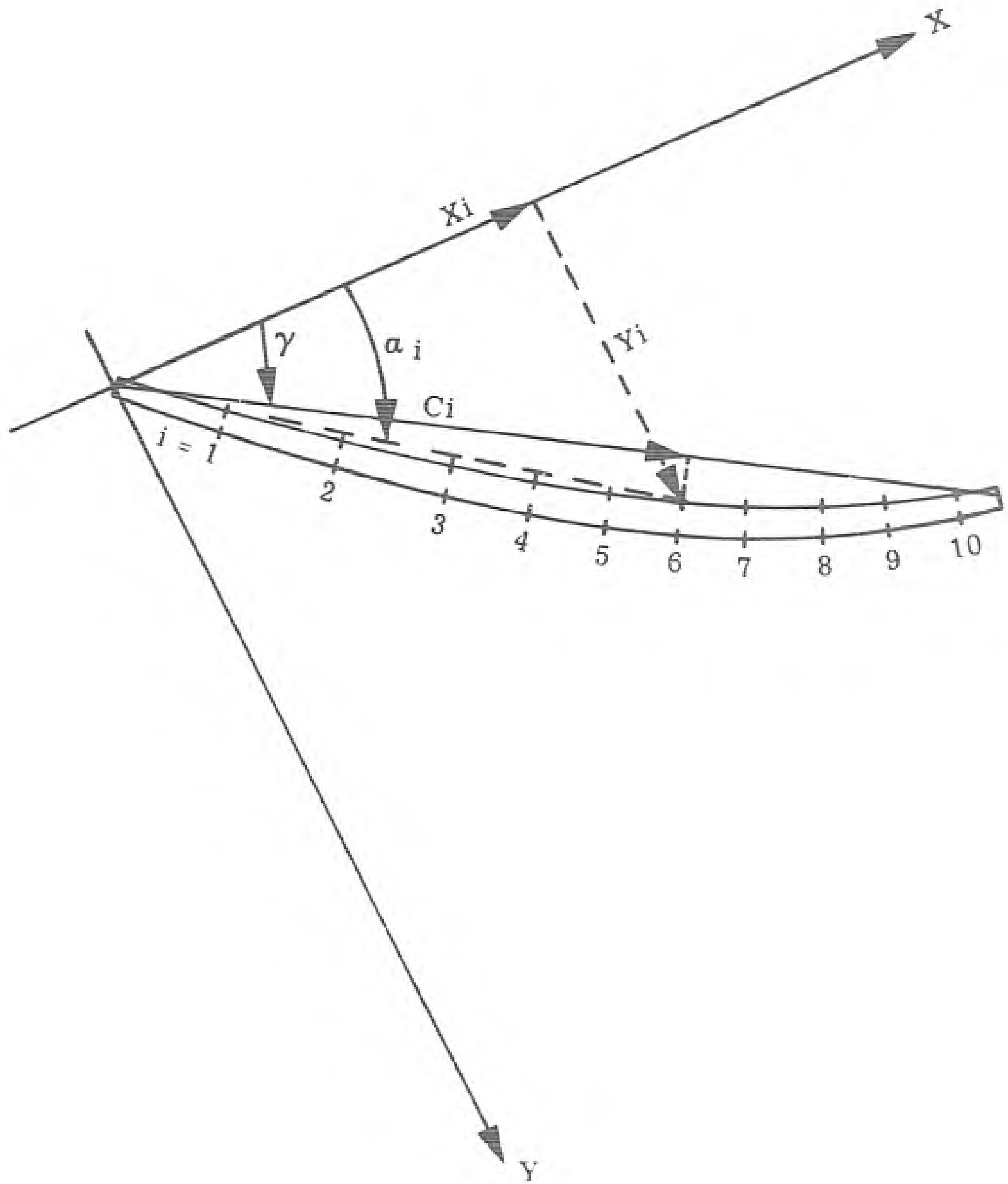

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FIGURE 25. SURFACE STATIC PRESSURE TAP LOCATIONS

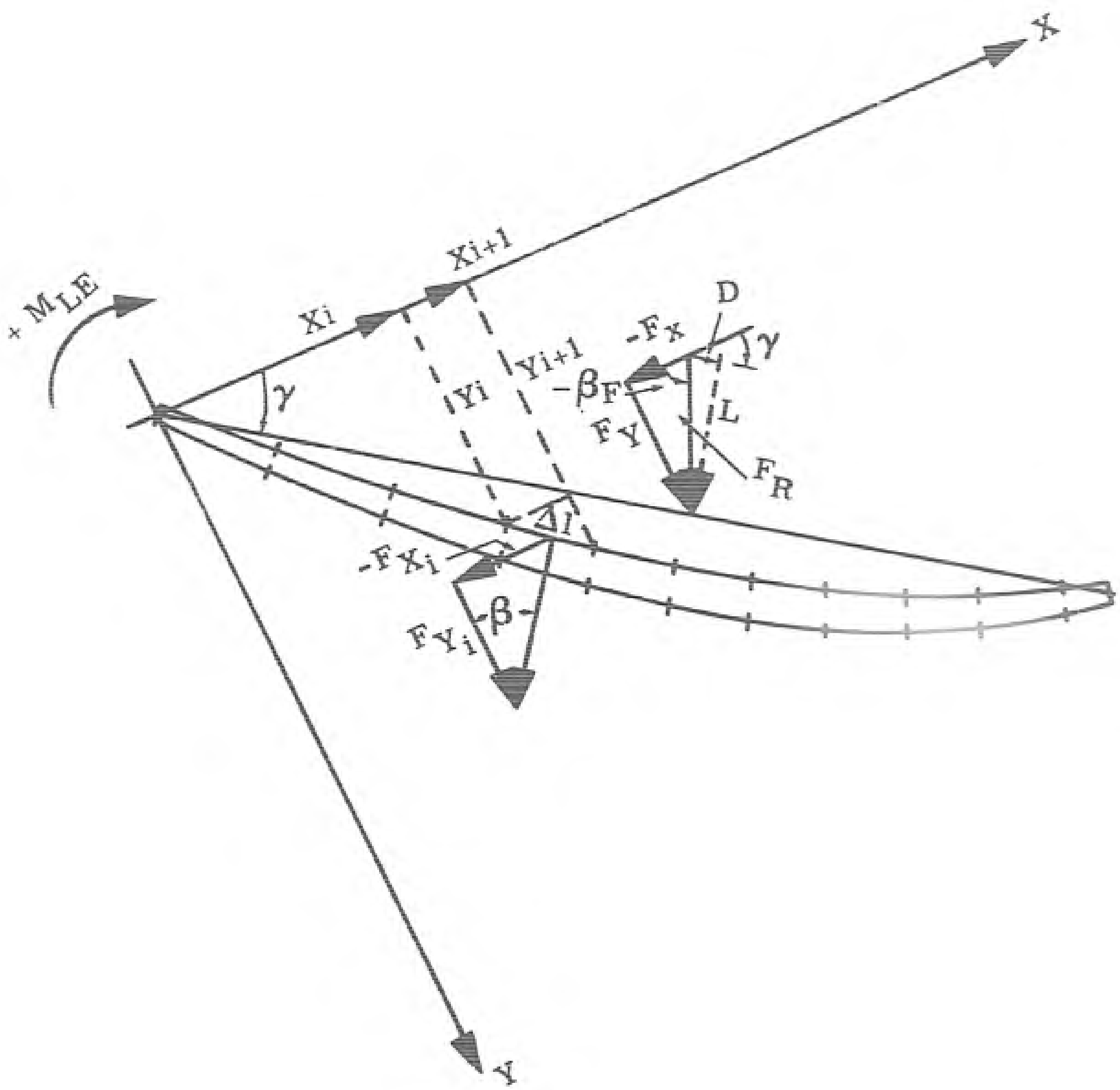

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FIGURE 26. INSTRUMENTED BLADES COORDINATE SYSTEM AND NOMENCLATURE IDENTIFICATION

surface is equal to the pressure on the suction surface. The same assumption is made at the trailing edge. Furthermore, if the pressure force between the leading edge and the first static port acts on an area equivalent to the average of the pressure and suction surface areas orientated at an average surface inclination, the leading edge pressure cancels in the force summation. The same is true for the trailing edge.

The force on the blade between the leading edge and first static pressure tap is determined by

$$F_{LE} = F_{LE_{PS}} - F_{LE_{SS}}$$

$$= \left(\frac{P_{1_{PS}} - P_{1_{SS}}}{2} \right) A_{S_{LE}}$$

where

$$A_{S_{LE}} = \frac{\left\{ \left[(X_1 - X_{LE})^2 + (Y_1 - Y_{LE})^2 \right]^{\frac{1}{2}} \left(\frac{B_1 + B_{LE}}{2} \right) \right\}_{PS}}{2} + \frac{\left\{ \left[(X_1 - X_{LE})^2 + (Y_1 - Y_{LE})^2 \right]^{\frac{1}{2}} \left(\frac{B_1 + B_{LE}}{2} \right) \right\}_{SS}}{2}$$

The average surface angle between the leading edge and the first static pressure tap is

$$\beta_{LE} = \frac{\tan^{-1} \left[\frac{Y_1 - Y_{LE}}{X_1 - X_{LE}} \right]_{PS} + \tan^{-1} \left[\frac{Y_1 - Y_{LE}}{X_1 - X_{LE}} \right]_{SS}}{2}$$

The same relations can be employed at the blade trailing edge:

$$F_{TE} = F_{TE_{PS}} - F_{TE_{SS}}$$

$$= \left(\frac{P_{n_{PS}} - P_{n_{SS}}}{2} \right) A_{S_{TE}}$$

where

$$A_{S_{TE}} = \frac{\left\{\left[(X_{TE} - X_n)^2 + (Y_{TE} - Y_n)^2\right]^{\frac{1}{2}} \left(\frac{B_{TE} + B_n}{2}\right)\right\}_{PS}}{2} + \frac{\left\{\left[(X_{TE} - X_n)^2 + (Y_{TE} - Y_n)^2\right]^{\frac{1}{2}} \left(\frac{B_{TE} + B_n}{2}\right)\right\}_{SS}}{2}$$

and

$$\beta_{TE} = \frac{\tan^{-1}\left[\frac{Y_{TE} - Y_n}{X_{TE} - X_n}\right]_{PS} + \tan^{-1}\left[\frac{Y_{TE} - Y_n}{X_{TE} - X_n}\right]_{SS}}{2}$$

where

n = total number of surface static taps

The total axial force on the blade is now determined by

$$F_X = \sum_{i=1}^{n-1} \left[\left(\frac{P_i + P_{i+1}}{2}\right) A_S \sin\beta\right]_{SS} - \sum_{i=1}^{n-1} \left[\left(\frac{P_i + P_{i+1}}{2}\right) A_S \sin\beta\right]_{PS}$$

$$- F_{LE} \sin\beta_{LE} - F_{TE} \sin\beta_{TE}$$

where

$$A_S = \Delta\ell\left[\frac{B_i + B_{i+1}}{2}\right]$$

$$\Delta\ell = \left[(X_{i+1} - X_i)^2 + (Y_{i+1} - Y_i)^2\right]^{\frac{1}{2}}$$

$$\beta = \tan^{-1}\left[\frac{(Y_{i+1} - Y_i)}{(X_{i+1} - X_i)}\right]$$

n = number of surface static pressure taps

Similarly, the total tangential force on the blade is

$$F_Y = \sum_{i=1}^{n-1} \left[\left(\frac{P_i + P_{i+1}}{2} \right) A_S \cos\beta \right]_{PS} - \sum_{i=1}^{n-1} \left[\left(\frac{P_i + P_{i+1}}{2} \right) A_S \cos\beta \right]_{SS}$$

$$+ F_{LE} \cos\beta_{LE} + F_{TE} \cos\beta_{TE}$$

The resultant force on the blade is calculated as

$$F_R = \sqrt{F_X^{\,2} + F_Y^{\,2}}$$

The direction of the resultant force is

$$\beta_F = \tan^{-1} \left(\frac{F_Y}{F_X} \right)$$

Referring again to Figure 26, one determines the moment exerted on the blade assuming clockwise rotation positive and calculated from the leading edge from the relation

$$M_{LE} = \sum_{i=1}^{n-1} \left[F_{X_i} \left(\frac{Y_{i+1} + Y_i}{2} \right) + F_{Y_i} \left(\frac{X_{i+1} + X_i}{2} \right) \right]_{PS}$$

$$- \sum_{i=1}^{n-1} \left[F_{X_i} \left(\frac{Y_{i+1} + Y_i}{2} \right) + F_{Y_i} \left(\frac{X_{i+1} + X_i}{2} \right) \right]_{SS}$$

$$+ F_{LE} \sin\beta_{LE} \left(\frac{Y_{LE} + Y_1}{2} \right) + F_{TE} \sin\beta_{TE} \left(\frac{Y_n + Y_{TE}}{2} \right)$$

$$+ F_{LE} \cos\beta_{LE} \left(\frac{X_{LE} + X_1}{2} \right) + F_{TE} \cos\beta_{TE} \left(\frac{X_n + X_{TE}}{2} \right)$$

The nondimensionalized force coefficients are determined by dividing the force by the product of inlet dynamic pressure, blade span, and blade chord. For cascades where the blade span is not constant, the average of the blade inlet and exit span is used.

Axial force coefficient F_{C_X}

$$F_{C_X} = \frac{F_X}{Q_1\left(\frac{B_1 + B_2}{2}\right) C}$$

Tangential force coefficient F_{C_Y}

$$F_{C_Y} = \frac{F_Y}{Q_1\left(\frac{B_1 + B_2}{2}\right) C}$$

Resultant force coefficient F_{C_R}

$$F_{C_R} = \frac{F_R}{Q_1\left(\frac{B_1 + B_2}{2}\right) C}$$

The nondimensionalized moment coefficient is determined by dividing the moment by the product of inlet dynamic pressure, blade span, and blade chord squared. Again the average of the blade inlet and exit span is used when the blade span is not constant.

Moment coefficient $M_{C_{LE}}$

$$M_{C_{LE}} = \frac{M_{LE}}{Q_1\left(\frac{B_1 + B_2}{2}\right) C^2}$$

Drag coefficient C_{D_1}

The drag coefficient is calculated upon assuming the drag force acts parallel to the blade chord:

$$C_{D_1} = F_{C_R} \cos (180 - \gamma + \beta_F)$$

Lift coefficient C_{L_1}

The lift coefficient is calculated upon assuming the lift force acts perpendicular to the blade chord:

$$C_{L_1} = F_{C_R} \sin (180 - \gamma + \beta_F)$$

Center of pressure $C_{P_{LE}}$

The center of pressure is determined as percent of chord from the blade leading edge:

$$C_{P_{LE}} = \frac{M_{LE}}{F_R C} (100)$$

CASCADE LOCAL EXIT PERFORMANCE

The local cascade exit conditions are determined by positioning a five port conical probe at discrete points across the cascade passage. The conical probe has been calibrated over a Mach number range of 0.35 to 1.80 at various incidence angles. The conical probe calibration procedure is discussed in Reference 7. From the calibration data, the wind tunnel on-line data acquisition system determines the flow Mach number (Mn_2), flow total pressure (P_{T2}), and flow direction relative to the conical probe centerline (β_P) at each discrete point at the cascade exit. The local exit flow direction referenced to the engine axial direction (β_2) is determined by

$$\beta_2 = 90 - \psi_P + \beta_P$$

where

ψ_P = Probe angle (angle between probe centerline and engine tangential direction), degrees

From the local exit Mach number, total pressure, and flow direction, the following local performance parameters are calculated.

Local exit axial Mach number Mn_{X_2}

$$Mn_{X_2} = Mn_2 \cos\beta_2$$

Local exit tangential Mach number Mn_{Y_2}

$$Mn_{Y_2} = Mn_2 \sin\beta_2$$

Local exit static pressure P_2

$$P_2 = \frac{P_{T_2}}{\left(1 + \frac{k-1}{2} Mn_2^2\right)^{\frac{k}{k-1}}}$$

Local exit total pressure recovery P_{R_T}

$$P_{R_T} = \frac{P_{T_2}}{P_{T_1}}$$

Local exit deviation angle $\delta°$

$$\delta° = \beta_2 - \kappa_{ML_2}$$

where

κ_{ML_2} = mean line blade metal angle at the trailing edge, degrees

Local exit turning angle $\Delta\beta$

$$\Delta\beta = \beta_1 - \beta_2$$

Local exit total temperature T_{T_2}

$$T_{T_2} = T_{T_1}$$

Local exit total to static temperature ratio $\frac{T_{T_2}}{T_2}$

$$\frac{T_{T_2}}{T_2} = 1 + \frac{k-1}{2} Mn_2^2$$

Local exit mass flow rate per inch span m_2

$$m_2 = \frac{\left[\left(P_2 Mn_{X_2}\sqrt{\frac{kg}{RT_{T_2}}}\sqrt{\frac{T_{T_2}}{T_2}}\right)_i + \left(P_2 Mn_{X_2}\sqrt{\frac{kg}{RT_{T_2}}}\sqrt{\frac{T_{T_2}}{T_2}}\right)_{i+1}\right](Y_{i+1} - Y_i)}{2}$$

where

Y = Conical probe tip tangential location, inches

i = Discrete point at which conical probe measurements are taken

Local exit flow velocity V_2

$$V_2 = Mn_2 \sqrt{kgRT_{T_2}} \sqrt{\frac{T_2}{T_{T_2}}}$$

MASS-AVERAGED CASCADE EXIT CONDITIONS

The mass-averaged cascade exit conditions are determined by mass-averaging of the local exit data (Mach number, flow angle, and total pressure recovery) from the relationship

$$< f > = \frac{\sum_{i=1}^{n-1} \left[f_i P_i Mn_{X,\,i} \sqrt{\frac{T_T}{T})_i} + f_{i+1} P_{i+1} Mn_{X,\,i+1} \right] \sqrt{\frac{T_T}{T})_{i+1}} \;\Big] (Y_{i+1} - Y_i)}{\sum_{i=1}^{n-1} \left[P_i Mn_{X,\,i} \sqrt{\frac{T_T}{T})} + P_{i+1} Mn_{X,\,i+1} \sqrt{\frac{T_T}{T})_{i+1}} \;\right] (Y_{i+1} - Y_i)}$$

where

- i = Probe measurement station
- n = Total number of points
- f_i = Discrete data to be mass-averaged
- P_i = Local static pressure, psi
- $Mn_{X,\,i}$ = Local axial Mach number
- $T_T/T)_i$ = Local total to static temperature ratio
- Y_i = Conical probe tip location in tangential direction, in.
- $< f >$ = Mass averaged variable

The following cascade exit parameters can be determined from the mass-averaged exit conditions.

Mass-averaged axial Mach number Mn_{X_2}

$$Mn_{X_2} = Mn_2 \cos\beta_2$$

Mass-averaged tangential Mach number Mn_{Y_2}

$$Mn_{Y_2} = Mn_2 \sin\beta_2$$

Mass-average total pressure P_{T_2}

$$P_{T_2} = (P_{T_1})\, P_{R_T}$$

Mass-averaged static pressure P_2

$$P_2 = \frac{P_{T_2}}{\left[1 + \frac{k-1}{2} Mn_2^{\,2}\right]^{\frac{k}{k-1}}}$$

Mass-averaged total temperature T_{T_2}

$$T_{T_2} = T_{T_1}$$

Mass-averaged total to static temperature ratio $\frac{T_{T_2}}{T_2}$

$$\frac{T_{T_2}}{T_2} = 1 + \frac{k-1}{2} Mn_2^{\,2}$$

Exit to inlet mass ratio $\frac{m_2}{m_1}$

$$\frac{m_2}{m_1} = \frac{P_2 Mn_{x_2} \sqrt{\frac{kg}{RT_{T_2}}} \sqrt{\frac{T_{T_2}}{T_2}}\; s}{m_1} \left(\frac{B_2}{B_1}\right)_P$$

where

s = Blade spacing, in.

$\left(\frac{B_2}{B_1}\right)_p$ = Exit to inlet span ratio at the probe measuring station

MIXED EXIT CONDITIONS

The local cascade exit discrete data can be "mixed-out" by using the conservation equations of one-dimensional gas dynamics to obtain the cascade exit properties in terms of a uniform exit flow field. The technique and applicable relationships for "mixing-out" the cascade discrete data are presented in Reference 8. The results of the mixing equations are the "mixed-out" Mach number (Mn_2), flow angle (β_2), total pressure (P_{T_2}), and total temperature (T_{T_2}). From these four mixed exit properties, additional cascade exit performance parameters such as those described for the mass-averaged exit conditions can be determined.

CASCADE OVERALL PERFORMANCE

The cascade overall performance parameters for either mass-averaged or mixed exit conditions are presented below.

Static pressure ratio P_R

$$P_R = \frac{P_2}{P_1}$$

Total pressure recovery P_{R_T}

$$P_{R_T} = \frac{P_{T_2}}{P_{T_1}}$$

Velocity ratio $\frac{V_2}{V_1}$

$$\frac{V_2}{V_1} = \frac{Mn_2 \sqrt{\frac{T_2}{T_{T_2}}}}{Mn_1 \sqrt{\frac{T_1}{T_{T_1}}}}$$

For $T_{T_2} = T_{T_1}$

Axial velocity ratio $\frac{V_{X_2}}{V_{X_1}}$

$$\frac{V_{X_2}}{V_{X_1}} = \frac{V_2 \cos\beta_2}{V_1 \cos\beta_1}$$

Tangential velocity ratio $\frac{V_{Y_2}}{V_{Y_1}}$

$$\frac{V_{Y_2}}{V_{Y_1}} = \frac{V_2 \sin\beta_2}{V_1 \sin\beta_1}$$

Density ratio $\frac{\rho_2}{\rho_1}$

$$\frac{\rho_2}{\rho_1} = \left(\frac{P_2}{P_1}\right) \left(\frac{\frac{T_{T_2}}{T_2}}{\frac{T_{T_1}}{T_1}}\right)$$

For $T_{T_2} = T_{T_1}$

Static temperature ratio $\frac{T_2}{T_1}$

$$\frac{T_2}{T_1} = \frac{T_{T_2}}{T_{T_1}} \left(\frac{1 + \frac{k-1}{2} Mn_1^2}{1 + \frac{k-1}{2} Mn_2^2}\right)$$

Total pressure loss coefficient ω

$$\omega = \frac{P_{T_1} - P_{T_2}}{P_{T_1} - P_1}$$

Total pressure loss parameter ω_p

$$\omega_p = \frac{\omega \cos\beta_2 \, s}{2\,C}$$

Diffusion factor D_f

$$D_f = 1 - \frac{V_2}{V_1} + \frac{\sin\beta_1 \, s}{2\,C} \left(1 - \frac{V_{Y_2}}{V_{Y_1}}\right)$$

Equivalent diffusion factor

$$D_{f_{eq}} = \frac{V_1}{V_2} \left[1.12 + .61 \frac{\cos^2\beta_1 \, s}{C} \left(\tan\beta_1 - \frac{V_{X_2}}{V_{X_1}} \tan\beta_2\right)\right]$$

Tangential velocity change $\frac{\Delta V_Y}{V_1}$

$$\frac{\Delta V_Y}{V_1} = \left(1 - \frac{V_{Y_2}}{V_{Y_1}}\right) \sin\beta_1$$

Reynolds number N_R

$$N_R = \frac{12\ P_2\ Mn_2 \sqrt{\frac{kg}{RT_{T_2}}} \sqrt{\frac{T_{T_2}}{T_2}}\ C}{\mu_2}$$

Static pressure rise parameter S

$$S = \frac{P_2 - P_1}{Q_1}$$

Deviation angle δ°

$$\delta^\circ = \beta_2 - \kappa_{ML_2}$$

where

κ_{ML_2} = mean line blade metal angle at the trailing edge, degrees

Turning angle $\Delta\beta$

$$\Delta\beta = \beta_1 - \beta_2$$

Exit flow direction based on continuity β_C

$$\beta_C = \cos^{-1}\left[\left(\frac{\rho_1}{\rho_2}\right) \left(\frac{V_1}{V_2}\right) \left(\frac{B_1}{B_2}\right)_P \cos\beta_1 \right]$$

Flow area ratio based on continuity $\frac{A_2}{A_1}$

$$\frac{A_2}{A_1} = \left(\frac{\rho_1}{\rho_2}\right) \left(\frac{V_{X_1}}{V_{X_2}}\right)$$

APPENDIX C

PERFORMANCE COMPUTER PRINT-OUT IDENTIFICATION

The supersonic wind tunnel on-line instrumentation system yields eleven pages of computer print-out describing the cascade performance for each test condition. This appendix briefly describes the contents of the computer print-out and the nomenclature used, and provides tables to simplify the location and identification of selected cascade data items. The computer print-out nomenclature is shown in Table IX.

On the first page of the print-out following the title lines, four entries which describe the test point operating conditions appear: cascade inlet Mach number, cascade ideal static pressure ratio, the cascade blade behind which the conical probe data was taken, and the conical probe axial location behind the blade row.

The second entry on the first page of print-out presents a listing of the pressures measured on the four Scanivalves. Table X identifies the pressures by Scanivalve and port number. The first seven ports of each Scanivalve are used for reference calibration pressures with alternate ports thereafter connected to a vacuum source to eliminate transducer hysteresis and minimize pneumatic settling time. From these pressures, the cascade performance presented on the fourth through sixth pages of the print-out are determined.

The last entry on the first page of print-out presents miscellaneous test section data, including the conical probe position in the exit flow field, test section angular position, and the wind tunnel total temperature.

The first entry on the second page of the print-out presents the nozzle exit flow field properties.

The second entry on the second page is the wedge and blade inlet flow parameters determined from the sidewall static pressure taps located in the sidewall ahead of the wedge and each blade.

The last entry on the second page describes the flow properties across the sharp leading edge wedge which is used to expand or compress the nozzle exit flow to establish the cascade inlet Mach number and flow direction. These items are presented in Table XI.

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TABLE IX. COMPUTER PRINT-OUT NOMENCLATURE

A	Cascade flow area (span X spacing), in^2
BETA	Angle, measured from axial direction, degrees
CD	Drag coefficient (drag force referenced parallel to blade chord normalized by inlet dynamic pressure, span, and chord)
C)F	Skin friction coefficient times one thousand
CL	Lift coefficient (lift force referenced perpendicular to blade chord normalized by inlet dynamic pressure, span, and chord)
CP	Center of pressure, percent chord from blade leading edge
DEV	Deviation angle, degrees
DF	Diffusion factor
DP	Total pressure loss (inlet minus exit total pressure), psi
DPS	Static pressure rise (local or exit minus inlet static pressure), psi
DV)Y	Ratio of tangential velocity change to inlet total velocity
FC	Force coefficient (blade force normalized by inlet dynamic pressure, span, and chord)
I	Incidence angle, degrees
LE	Leading edge
M	Mass flow rate • Nozzle exit - total mass flow, lbs/sec • Cascade inlet and exit - mass flow per passage per inch span, lbs/sec-in.
MC	Moment coefficient (moment exerted on blade about leading edge normalized by inlet dynamic pressure, span, and chord squared)
ML	Mean line reference

TABLE IX. COMPUTER PRINT-OUT NOMENCLATURE (Continued)

MN	Mach number
NR RN	Reynolds number divided by 1 million
OMEGA	Total pressure loss coefficient
P	Static pressure, psi
PERCT	Tangential reference position of conical probe tip, percent of passage
PS	Pressure surface
PT	Total pressure, psi
Q	Dynamic pressure, psi
Q1	Inlet dynamic pressure, psi
R	Density, lb/ft^3
SS	Suction surface
T	Static temperature, degrees R
T/C	Maximum blade thickness to chord ratio
TPLP	Total pressure loss parameter
TT	Total temperature, degrees R
TURN	Flow turning angle (inlet minus exit), degrees
V	Velocity, fps
Y	Tangential reference position of conical probe tip, inches

Subscripts:

0	Nozzle exit condition
1	Cascade inlet condition
2	Cascade exit condition
A	Average condition

TABLE IX. COMPUTER PRINT-OUT NOMENCLATURE (Continued)

Subscripts: (Continued)

BP	Conical probe bottom static port in vertical plane calculated from continuity equation
EQ	Equivalent
F	Referenced to resultant force direction
LE	Leading edge
ML	Mean line
NP	Conical probe north static port in horizontal plane
P	Referenced to conical probe centerline
PS	Pressure surface
SP	Conical probe south static port in horizontal plane
SS	Suction surface
TP	Conical probe top static port in vertical plane
X	Referenced to axial direction
Y	Referenced to tangential direction
YP	Conical probe total pressure port

TABLE X
SCANIVALVE PORT ASSIGNMENTS

Calibration Pressure #1 = 10 psi
Calibration Pressure #2 = 20 psi

Port No.	Scanivalve No. 4 (0 - 50 psi)	Port No.	Scanivalve No. 1 (0 - 15 psi)
1	Vacuum	1	Vacuum
2	Vacuum	2	Vacuum
3	Calibration Vacuum	3	Calibration Vacuum
4	Calibration Pressure No. 1	4	Calibration Pressure No. 1
5	Calibration Pressure No. 1	5	Calibration Pressure No. 1
6	Calibration Pressure No. 2	6	Calibration Pressure No. 2
7	Calibration Pressure No. 2	7	Calibration Pressure No. 2
8	Vacuum	8	Vacuum
9	Tunnel Total Pressure	9	Tunnel Total Pressure
10	Vacuum	10	Vacuum
11	Blade PS Static #1	11	Blade SS Static #1
12	Vacuum	12	Vacuum
13	Blade PS Static #2	13	Blade SS Static #2
14	Vacuum	14	Vacuum
15	Blade PS Static #3	15	Blade SS Static #3
16	Vacuum	16	Vacuum
17	Blade PS Static #4	17	Blade SS Static #4
18	Vacuum	18	Vacuum
19	Blade PS Static #5	19	Blade SS Static #5
20	Vacuum	20	Vacuum
21	Blade PS Static #6	21	Blade SS Static #6
22	Vacuum	22	Vacuum
23	Blade PS Static #7	23	Blade SS Static #7
24	Vacuum	24	Vacuum
25	Blade PS Static #8	25	Blade SS Static #8
26	Vacuum	26	Vacuum
27	Blade PS Static #9	27	Blade SS Static #9
28	Vacuum	28	Vacuum
29	Blade PS Static #10	29	Blade SS Static #10
30	Vacuum	30	Vacuum
31	Tunnel Total Pressure	31	Tunnel Total Pressure
32	Vacuum	32	Vacuum
33	Tailboard Static #1	33	Upper Splitter Cavity #1
34	Vacuum	34	Vacuum
35	Tailboard Static #2	35	Upper Splitter Cavity #2
36	Vacuum	36	Vacuum
37	Tailboard Static #3	37	Tailboard Cavity
38	Vacuum	38	Vacuum
39	Access Cover Pressure	39	Nozzle Ext. Plenum Press. #1
40	Vacuum	40	Vacuum
41	Primary Ejector Pressure	41	Nozzle Ext. Plenum Press. #2
42	Vacuum	42	Vacuum
43	Top Bleed Pressure	43	Nozzle Ext. Plenum Press. #3
44	Vacuum	44	Vacuum
45	Bottom Bleed Pressure	45	Upstream Bleed Orf. Press.(Nozzle)
46	Vacuum	46	Vacuum
47	Tunnel Total Pressure	47	Tunnel Total Pressure
48	Vacuum	48	Vacuum

NOTE: 1) Sidewall Statics Numbered Front to Back
2) All Probe Taps to be Plumbed Straight through Scanivalve Patch Panel
3) Remove Roll Pins and Felt from all Ports Used

TABLE X (Continued)
SCANIVALVE PORT ASSIGNMENTS

Calibration Pressure #1 = 10 psi
Calibration Pressure #2 = 20 psi

Port No.	Scanivalve No. 3 (0 - 30 psi)	Port No.	Scanivalve No. 2 (0 - 15 psi)
1	Vacuum	1	Vacuum
2	Vacuum	2	Vacuum
3	Calibration Vacuum	3	Calibration Vacuum
4	Calibration Pressure No. 1	4	Calibration Pressure No. 1
5	Calibration Pressure No. 1	5	Calibration Pressure No. 1
6	Calibration Pressure No. 2	6	Calibration Pressure No. 2
7	Calibration Pressure No. 2	7	Calibration Pressure No. 2
8	Vacuum	8	Vacuum
9	Tunnel Total Pressure	9	Tunnel Total Pressure
10	Vacuum	10	Vacuum
11	Probe Total Pressure	11	North Bleed Cavity No. 3
12	Vacuum	12	Vacuum
13	Probe Top Static	13	North Bleed Cavity No. 4
14	Vacuum	14	Vacuum
15	Probe Bottom Static	15	North Bleed Cavity No. 5
16	Vacuum	16	Vacuum
17	Probe North Static	17	South Bleed Cavity No. 3
18	Vacuum	18	Vacuum
19	Probe South Static	19	South Bleed Cavity No. 4
20	Vacuum	20	Vacuum
21	Tunnel Total Pressure	21	Tunnel Total Pressure
22	Vacuum	22	Vacuum
23	Exit Static No. 1	23	Wedge Static No. 1 South
24	Vacuum	24	Vacuum
25	Exit Static No. 2	25	Wedge Static No. 2 North
26	Vacuum	26	Vacuum
27	Exit Static No. 3	27	Inlet Static No. 1
28	Vacuum	28	Vacuum
29	Exit Static No. 4	29	Inlet Static No. 2
30	Vacuum	30	Vacuum
31	Exit Static No. 5	31	Inlet Static No. 3
32	Vacuum	32	Vacuum
33	Mid-Channel Static No. 1	33	Inlet Static No. 4
34	Vacuum	34	Vacuum
35	Mid-Channel Static No. 2	35	Inlet Static No. 5
36	Vacuum	36	Vacuum
37	Mid-Channel Static No. 3	37	Inlet Static No. 6
38	Vacuum	38	Vacuum
39	Mid-Channel Static No. 4	39	North Bleed Plenum Pressure
40	Vacuum	40	Vacuum
41	Mid-Channel No. 5	41	South Bleed Plenum Pressure
42	Vacuum	42	Vacuum
43	South Bleed Cavity No. 5	43	North Bleed Manifold Pressure
44	Vacuum	44	Vacuum
45	Tunnel Total Pressure	45	South Bleed Manifold Pressure
46	Vacuum	46	Vacuum
47	Tunnel Total Pressure	47	Tunnel Total Pressure
48	Vacuum	48	Vacuum

NOTE: 1) Sidewall Statics Numbered Front to Back
2) All Probe Taps to be Plumbed Straight through Scanivalve Patch Panel
3) Remove Roll Pins and Felt from all Ports Used

TABLE XI. COMPUTER PRINT-OUT IDENTIFICATION - NOZZLE EXIT CONDITIONS AND BLADE INLET STATIC PRESSURES ON SECOND PAGE

Nozzle Exit Mach No. MN)0	Nozzle Exit Total Pressure (psi) PT)0	Nozzle Exit Total Temperature (°R) TT)0	Nozzle Exit Total Mass Flow (lbs/sec) MN)0	Nozzle Exit Flow Direction (Degrees) BETA)0
Blade	Static Pressure	Mach Number		

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The first entry on the third page of the print-out consists of two lines describing the cascade physical design parameters.

The last entry on the third page describes the cascade inlet flow field conditions. Identification of the cascade inlet parameters is presented in Table XII.

The entry on the fourth page of the computer print-out is the cascade ideal performance based on sidewall static pressures. Included is a listing of the pressures presented on the second page of the print-out for the sidewall static pressure taps. From these pressures, a mean exit static pressure and RMS deviation are calculated along with the same parameters for the mid-passage static pressure taps. The cascade ideal exit Mach number and ideal static pressure ratio are determined from the mean exit static pressure.

The fifth page of the computer print-out describes the sidewall boundary layer bleed system performance, including sidewall slot pressures, sidewall boundary layer bleed flow rate, and the ratio of bleed mass flow rate to total cascade inlet mass flow.

The sixth page of the computer print-out describes the instrumented blade parameters. The first entry presents the static pressure distribution on the cascade blade surface along with associated columns describing local performance characteristics and static tap locations in terms of percent chord. Following the local surface performance characteristics are several additional parameters summarizing the instrumented blade performance. Table XIII provides additional identification of the entries on the sixth page.

The local cascade exit performance was determined by utilizing a conical probe to measure Mach number, flow angle, and total pressure at twenty discrete points across one passage of the cascade. The probe was positioned at the center of cascade passage number 3 and measurements taken in five percent steps to the center of passage number 4 (data obtained behind blade number 4). The seventh, eighth, and ninth pages of the computer print-out present the local exit performance characteristics of the cascade. Table XIV provides the identification for the parameters presented on these pages.

The cascade exit flow field properties are determined by mass-averaging and mixing to uniform flow the local exit parameters. Identification of the exit flow field parameters on the tenth page of the computer print-out is presented in Table XV.

The cascade overall performance characteristics relating the inlet and exit properties are presented on the eleventh page of the computer print-out and are identified in Table XVI.

TABLE XII. COMPUTER PRINT-OUT IDENTIFICATION - CASCADE INLET CONDITIONS ON THIRD PAGE

Inlet Mach Number	Inlet Total Pressure (psi)	Inlet Total Temperature (°R)	Inlet Flow Direction (Degrees)	Inlet Static Pressure (psi)	Inlet Mass Flow Rate per Passage per inch span (lb/sec-in)	Inlet Dynamic Pressure (psi)
MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1

Suction Surface Incidence (Degrees)	Mean Line Incidence (Degrees)	Inlet Axial Mach Number	Inlet Tangential Mach Number	Inlet Total to Static Temperature Ratio	Inlet Total to Static Pressure Ratio	Inlet Reynolds Number
I)SS	I)ML	MN)X.1	MN)Y.1	TT/T)1	PT/P)1	NR/10**6

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TABLE XIII. COMPUTER PRINT-OUT IDENTIFICATION - INSTRUMENTED BLADE PARAMETERS ON SIXTH PAGE

Local Pressure Surface Static Pressure (psi)	Local Suction Surface Static Pressure (psi)	Local Static Pressure Rise Parameter-Pressure Surface	Local Static Pressure Rise Parameter-Suction Surface	Ratio of Local Static Pressure to Inlet Total Pressure-Pressure Surface	Ratio of Local Static Pressure to Inlet Total Pressure - Suction Surface	Static Port Location - % Chord from Leading Edge - Pressure Surface	Static Port Location - % Chord from Leading Edge - Suction Surface
PS	SS	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PS	SS

Resultant Force Coefficient	Axial Force Coefficient	Tangential Force Coefficient	Resultant Force Direction (Degrees)	Drag Coefficient	Lift Coefficient	Moment Coefficient	Center of Pressure -
FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE

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TABLE XIV. COMPUTER PRINT-OUT IDENTIFICATION - LOCAL CASCADE EXIT PERFORMANCE ON SEVENTH, EIGHTH AND NINTH PAGE

Conical Probe Tangential Position (in)	Y
Exit Mach Number	MN)2
Exit Axial Mach Number	MN)X,2
Exit Tangential Mach Number	MN)Y,2
Exit Total Pressure (psi)	PT)2
Exit Static Pressure (psi)	P)2
Total Pressure Recovery	PT)2/PT)1
Exit Flow Direction (Degrees)	BETA)2
Conical Probe Tangential Position - % Passage	PERCT
Deviation Angle (Degrees)	DEV
Flow Turning Angle (Degrees)	TURN
Local Exit Mass Flow per inch span (lbs/sec-in.)	M)2
Total Pressure Loss (psi)	DP)1,2
Exit Flow Velocity (fps)	V)2
Nozzle Exit Total Pressure - Start of Probe Traverse (psi)	PT)0
Nozzle Exit Total Pressure - End of Probe Traverse (psi)	PT)0
Nozzle Exit Average Total Pressure (psi)	PT)0,A
Conical Probe Total Pressure (psi)	PT)TP
Conical Probe Static Pressure Top Port in Vertical Plane (psi)	P)TP
Conical Probe Static Pressure Bottom Port in Vertical Plane (psi)	P)BP
Conical Probe Static Pressure North Port in Horizontal Plane (psi)	P)NP
Conical Probe Static Pressure - South Port in Horizontal Plane (psi)	P)SP
Flow Direction Referenced to Probe Centerline (Degrees)	BETA)P
Inlet Total Pressure (psi)	PT)1
Inlet Total Temperature (°R)	TT)1

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TABLE XV. COMPUTER PRINT-OUT IDENTIFICATION - MASS AVERAGED AND MIXED EXIT CONDITIONS ON TENTH PAGE

MASS AVERAGED EXIT CONDITIONS

Exit Mach Number	Exit Flow Direction (Degrees)	Total Pressure Recovery
MN)2	BETA)2	PT)2/PT)1

CASCADE EXIT PARAMETERS BASED ON MASS AVERAGED CONDITIONS

Exit Axial Mach Number	Exit Tangential Mach Number	Exit Total Pressure (psi)	Exit Static Pressure (psi)	Exit Total Temperature (°R)	Exit Total to Static Temperature Ratio	Exit to Inlet Mass Flow Ratio
MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1

MIXED EXIT CONDITIONS

Exit Axial Mach Number	Exit Tangential Mach Number	Exit Total Pressure (psi)	Exit Static Pressure (psi)	Exit Total Temperature (°R)	Exit Total to Static Temperature Ratio	Exit Mach Number	Exit Flow Direction (Degrees)
MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2

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TABLE XVI. COMPUTER PRINT-OUT IDENTIFICATION - OVERALL PERFORMANCE ON ELEVENTH PAGE

Static Pressure Ratio P)2/P)1	Total Pressure Recovery PT)2/PT)1	Velocity Ratio V)2/V)1	Axial Velocity Ratio V)2/V)1,X	Tangential Velocity Ratio V)2/V)1,Y	Density Ratio R)2/R)1	Static Temperature Ratio T)2/T)1	Total Pressure Loss Coefficient OMEGA
Total Pressure Loss Parameter TPLP	Diffusion Factor DF	Equivalent Diffusion Factor DF)EQ	Ratio of Tangential Velocity Change to Inlet Velocity DV)Y	Exit Reynolds Number RN)2	Static Pressure Rise Parameter DPS/Q1	Deviation Angle (Degrees) DEV	Flow Turning Angle (Degrees) TURN
Exit Flow Direction Calculated from Continuity (Degrees) BETA)E	Flow Area Ratio Calculated from Continuity A)2/A)1						

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APPENDIX D

CASCADE PERFORMANCE DATA

MN)1 = 1.535

P)2/P)1 = 1.190

P)2/P)1 = 1.356

P)2/P)1 = 1.399

P)2/P)1 = 1.505

P)2/P)1 = 1.686

P)2/P)1 = 1.970

P)2/P)1 = 2.003

P)2/P)1 = 2.035

P)2/P)1 = 2.076

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SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.535	1.182	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.554	18.576	18.565	18.591
11	17.800	4.708	5.734	5.254
13	7.765	4.820	5.177	5.292
15	8.001	4.685	5.057	5.260
17	7.710	4.701	4.915	4.953
19	8.105	4.824	4.514	4.959
21	18.494	18.542	4.679	4.844
23	5.756	5.009	4.889	4.568
25	5.623	4.998	4.926	4.921
27	5.844	4.785	6.916	6.613
29	5.680	4.838	6.525	5.526
31	5.374	4.791	18.583	18.585
33	6.071	4.689	4.553	2.177
35	5.811	4.872	5.062	4.993
37	5.339	4.748	5.653	5.025
39	5.170	5.069	3.983	4.852
41	4.124	5.060	4.308	4.854
43	4.695	1.489	3.890	5.005
45	18.545	1.500	3.716	1.478
47	18.585	18.569	18.577	18.577

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.892	1.501	31.000	31.200	572.803

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN10	PT10	TT10	M10	BETA10
1.500	18.545	572.803	0.307	58.820

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.009	1.506
WEDGE	25	4.998	1.507
BLADE	27	4.785	1.537
BLADE	29	4.838	1.530
BLADE	31	4.791	1.536
BLADE	33	4.689	1.551
BLADE	35	4.872	1.525
BLADE	37	4.746	1.543

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.506	-.008	40.649	1.535	1.000	.961

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
56.934	2.733	1.787	.025	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
50.947	53.797	52.032	5[illegible].923

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	[illegible]ETA,1	P)1	M)1	Q)1
1.535	18.545	572.303	58.000	4.800	.325	7.918

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
4.203	5.968	.813	1.302	1.471	3.863	1.162

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	5.756	33	6.071
25	5.623	35	5.811
27	5.844	37	5.339
29	5.680	39	5.170
31	5.374	41	4.124

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
5.655	.159	5.303	.672	1.421	1.178

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	5.069	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.060	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.052	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.054	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	5.005	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	562.114	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.478	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.089	PSIA
SECONDARY BLEED FLOW RATE	=	.364	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.044	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	5.734	5.254	.118	.057	.309	.283	18.65	18.64
13	5.177	5.292	.048	.062	.279	.285	27.14	27.15
15	5.057	5.200	.032	.058	.273	.284	35.64	35.64
17	4.915	4.953	.014	.019	.265	.267	44.09	44.12
19	4.514	4.959	-.036	.020	.243	.267	52.62	52.62
21	4.679	4.844	-.015	.005	.252	.261	61.11	61.10
23	4.889	4.568	.011	-.029	.264	.246	69.57	69.61
25	4.926	4.921	.016	.015	.266	.265	78.08	78.13
27	6.916	6.613	.267	.229	.373	.357	86.57	86.60
29	6.525	5.526	.218	.092	.352	.298	95.04	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.013	-.012	.006	-25.582	-.002	.013	.009	71.888

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
	6.100	1.391	.677	1.215	18.545	5.982	1.000	60.886
.00	5.963	-2.886	.800	.800	1385.618	18.555	18.585	18.530
	17.818	8.151	7.666	7.769	8.168	1.878	18.538	573.838
	6.189	1.486	.691	1.225	18.545	5.778	1.000	60.573
4.98	5.650	-2.573	.816	.800	1398.416	18.582	18.524	18.553
	17.739	7.956	7.548	7.664	8.006	1.573	18.553	573.838
	6.278	1.424	.721	1.228	18.434	5.683	.994	59.575
9.96	4.652	-1.575	.816	.111	1408.817	18.587	18.526	18.556
	17.551	7.628	7.483	7.497	7.742	.565	18.556	573.838
	6.368	1.458	.746	1.253	18.471	5.344	.996	59.210
15.00	4.287	-1.210	.817	.074	1432.856	18.544	18.533	18.539
	17.400	7.306	7.252	7.087	7.524	.210	18.539	575.217
DELP PROBE -.053								
	6.457	1.498	.761	1.281	18.545	5.125	1.000	59.302
19.98	4.379	-1.392	.816	.800	1454.656	18.558	18.499	18.529
	17.350	7.894	7.816	6.839	7.385	.302	18.529	573.493
DELP PROBE -.247								
	6.546	1.513	.774	1.308	18.545	4.958	1.000	59.234
24.96	4.311	-1.234	.816	.800	1469.979	18.565	18.519	18.542
	17.394	6.951	6.890	6.758	7.165	.234	18.542	573.493
DELP PROBE -.165								
	6.637	1.518	.770	1.308	18.545	4.923	1.000	59.514
30.95	4.591	-1.51-	.816	.800	1473.241	18.584	18.541	18.563
	17.289	6.910	6.777	6.713	7.078	.514	18.563	572.883

DELP PROBE -.039

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
	6.726	1.518	.772	1.307	18.545	4.919	1.000	59.449
35.83	4.526	-1.449	.816	.800	1473.571	18.563	18.535	18.549
	17.169	6.865	6.752	6.614	7.845	.459	18.549	573.836
	6.815	1.327	.788	1.067	17.466	6.075	.949	53.555
40.81	-1.358	4.445	.817	1.879	1338.762	18.565	18.505	18.535
	17.019	7.270	6.572	8.212	8.171	-5.455	18.535	574.103
	6.904	1.396	.666	1.227	17.791	5.624	.959	61.511
44.99	6.558	-3.511	.817	.754	1389.819	18.568	18.512	18.536
	17.888	7.896	7.274	7.397	7.718	2.581	18.536	573.838
	6.993	1.310	.637	1.145	16.254	5.783	.876	60.931
49.97	6.000	-2.931	.815	2.298	1328.394	18.579	18.523	18.546
	15.889	7.881	7.451	7.353	7.971	1.921	18.546	574.528
	7.083	1.184	.597	1.023	13.611	5.738	.734	59.738
55.01	4.015	-1.738	.814	4.934	1227.586	18.593	18.533	18.563
	13.532	7.687	7.554	7.348	7.598	.738	18.563	574.872
	7.172	1.239	.712	1.014	15.342	6.011	.827	54.913
59.99	-.010	3.087	.815	3.282	1271.324	18.578	18.535	18.557
	15.166	7.559	8.403	7.628	7.947	-4.097	18.557	573.836
	7.261	1.289	.735	1.058	16.973	6.221	.915	55.223
64.97	.300	2.777	.817	1.572	1309.814	18.578	18.507	18.543
	16.655	7.769	8.632	7.985	8.466	-3.777	18.543	573.493

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)WP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.01	7.351 1.767 17.451	1.304 1.310 8.157	.710 .810 8.720	1.080 .715 8.265	17.829 1321.123 8.766	6.484 18.575 -2.313	.961 18.510 18.542	56.690 18.542 574.183
74.99	7.440 1.924 17.773	1.360 1.153 7.810	.740 .810 8.358	1.145 .143 7.973	18.402 1360.891 8.247	6.849 18.587 -2.153	.992 18.538 18.563	56.847 18.563 575.217
79.97	7.529 1.759 17.745	1.403 1.310 7.504	.771 .810 8.104	1.173 .000 7.721	18.545 1394.479 7.927	5.809 18.580 -2.326	1.000 18.537 18.562	56.682 18.562 574.528
85.00	7.619 2.422 17.724	1.482 .655 7.571	.757 .818 8.000	1.181 .037 7.830	18.508 1393.594 7.856	5.798 18.587 -1.665	.998 18.533 18.568	57.345 18.560 573.493
DELP PROBE -.200								
89.98	7.708 3.307 17.099	1.452 -.230 7.388	.765 .017 7.592	1.234 .000 7.240	18.545 1420.677 7.598	5.412 18.573 -.780	1.000 18.510 18.542	58.230 18.542 573.838
94.96	7.707 .762 17.546	1.335 2.315 7.031	.752 .815 8.653	1.102 .509 7.951	18.035 1344.538 8.581	6.207 18.571 -3.315	.973 18.521 18.546	55.685 18.546 574.183
DELP PROBE -.026								
100.00	7.887 2.024 17.828	1.392 .253 7.784	.743 .818 8.105	1.178 .000 7.729	18.545 1380.673 8.128	5.890 18.588 -1.253	1.000 18.534 18.560	57.747 18.560 574.183

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
1.386	58.024	.961

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.734	1.176	17.828	5.711	572.803	1.384	1.028

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.726	1.172	17.641	5.709	572.804	1.380	1.379	58.226

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

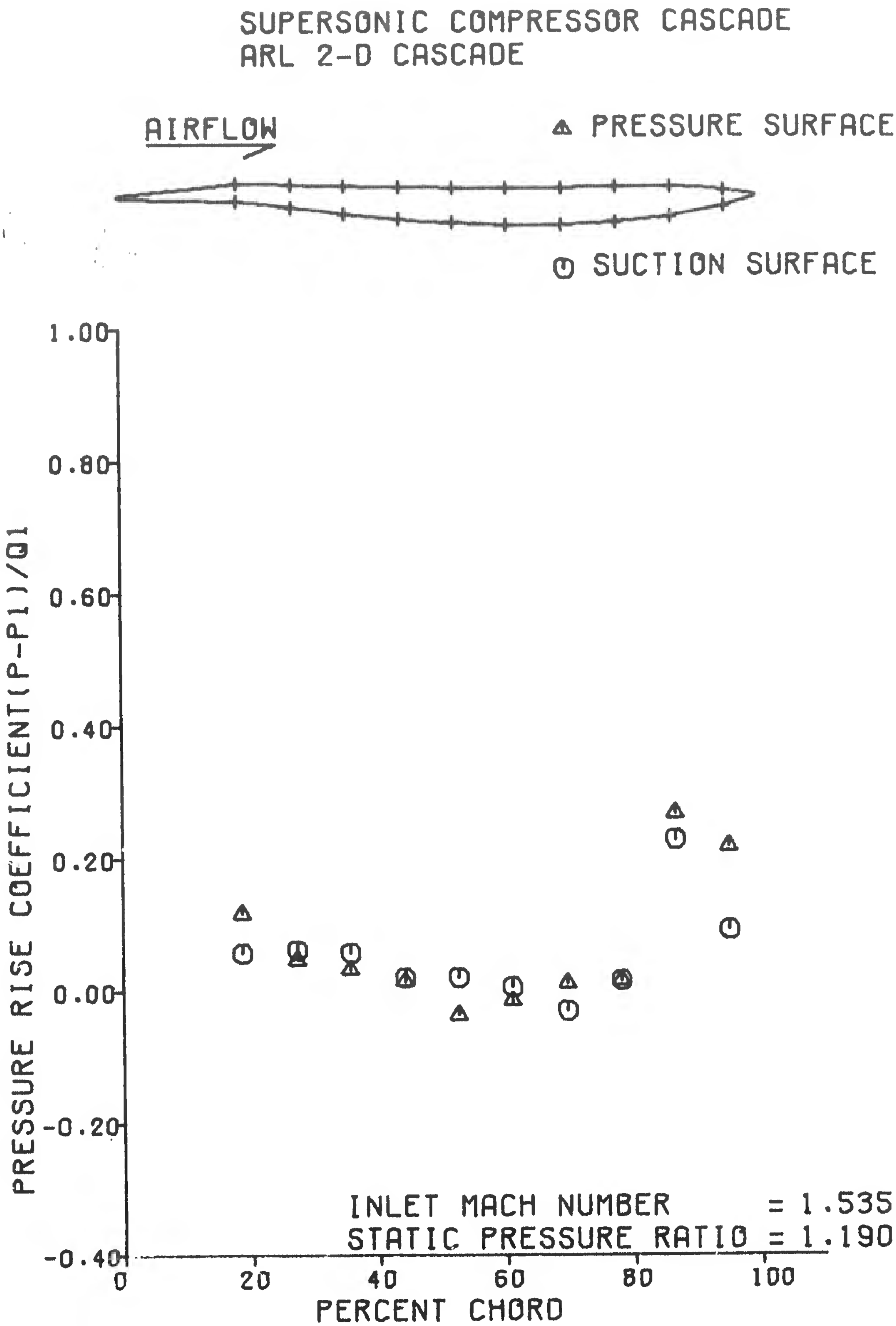
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.190	.961	.931	.930	.931	1.119	1.063	.053
.029	.088	1.216	.058	1.156	.115	3.101	-.024
59.430	.960						

OVERALL PERFORMANCE

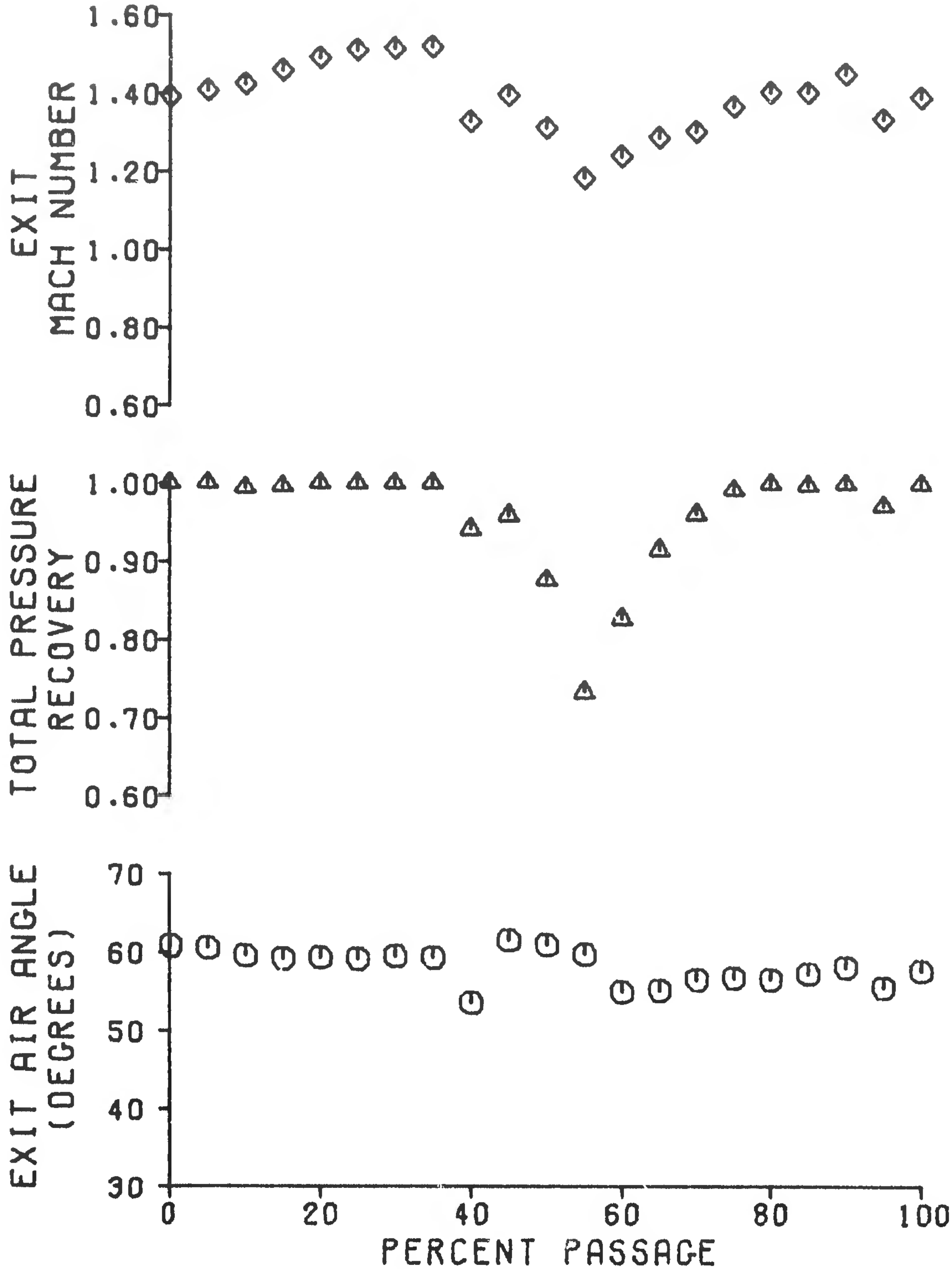
MIXED EXIT CONDITIONS

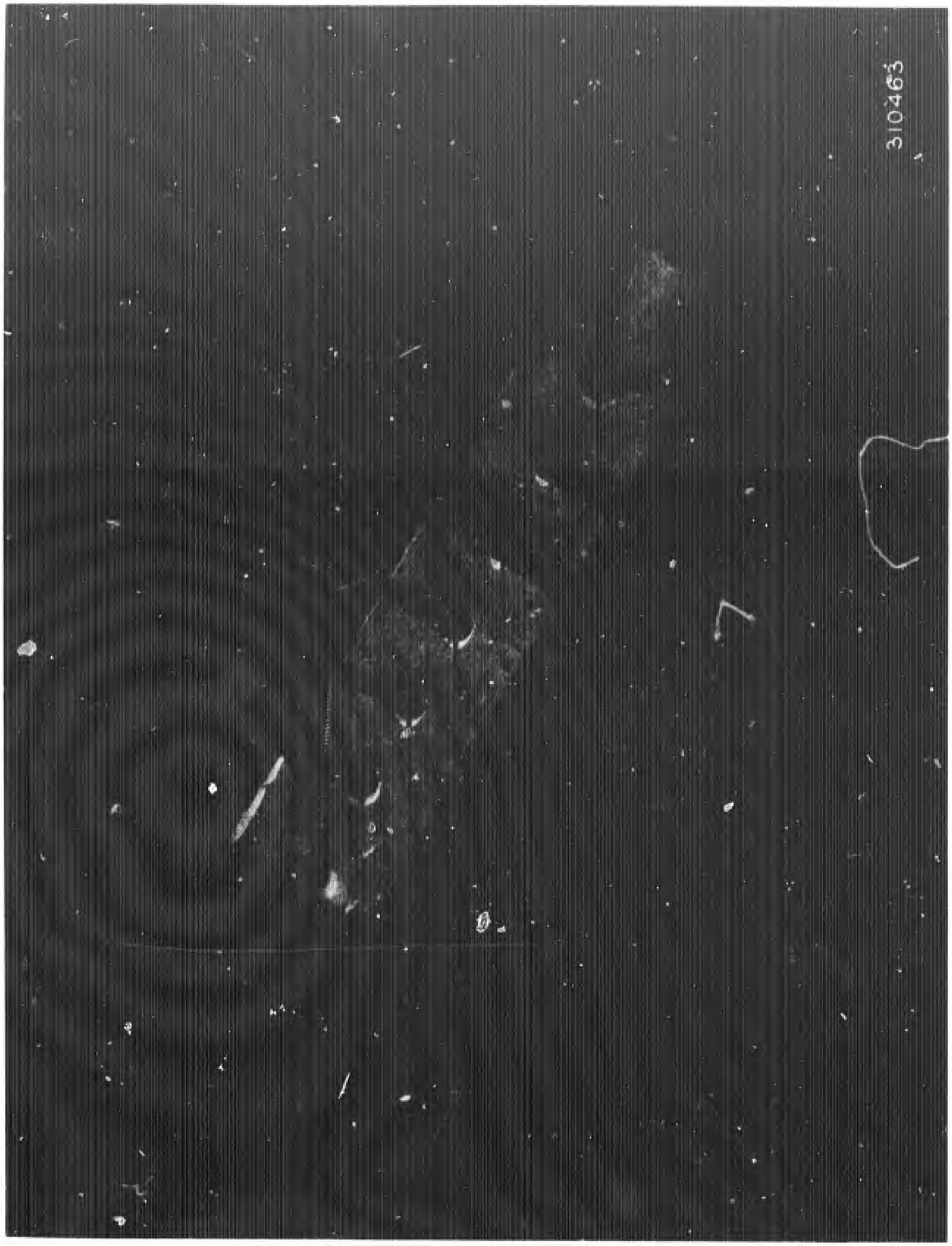
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.189	.951	.927	.922	.930	1.116	1.066	.066
.011	.092	1.221	.060	1.146	.115	3.303	-.226
59.199	.972						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
PRESSURE RISE COEFFICIENT(P-P1)/Q1
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.535
STATIC PRESSURE RATIO = 1.190

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES, = 0.680
CASCADE INLET MACH NUMBER = 1.535
CASCADE STATIC PRESSURE RATIO = 1.190





CASCADE SCHLIEREN

MN)1 = 1.535, P)2/P)1 = 1.190

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.535	1.381	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.586	18.572	18.572	18.584
11	17.840	4.707	5.733	5.256
13	8.493	4.810	5.175	5.293
15	7.931	4.665	5.043	5.262
17	8.156	4.698	4.909	4.958
19	8.224	4.823	4.488	4.948
21	19.521	18.550	4.700	4.836
23	6.280	5.009	4.943	4.558
25	6.636	4.995	5.559	4.905
27	5.889	4.780	7.581	6.624
29	6.765	4.838	7.529	5.524
31	6.612	4.786	18.570	18.580
33	5.343	4.685	6.414	2.182
35	6.465	4.816	6.577	4.998
37	6.562	4.739	6.568	6.784
39	6.570	5.064	7.604	4.835
41	7.479	5.063	4.445	4.813
43	4.669	1.499	4.808	4.862
45	18.542	1.513	3.779	1.492
47	18.553	18.543	18.558	18.560

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.890	1.501	30.990	31.210	573.148

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN)O	PT)O	TT)O	M)O	BETA)O
1.508	18.553	573.148	8.309	58.798

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.009	1.506
WEDGE	25	4.995	1.508
BLADE	27	4.780	1.538
BLADE	29	4.838	1.530
BLADE	31	4.786	1.537
BLADE	33	4.685	1.552
BLADE	35	4.816	1.533
BLADE	37	4.739	1.544

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.509	-.799	40.660	1.335	1.008	.962

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
56.934	2.733	1.707	.025	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
50.947	53.797	52.032	54.923

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.535	10.553	573.148	58.000	4.005	.325	7.922

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
4.203	5.968	.813	1.302	1.471	3.061	1.162

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	6.280	33	6.343
25	5.636	35	6.465
27	6.889	37	6.562
29	6.765	39	6.570
31	6.612	41	7.479

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
6.637	.204	6.604	.406	1.307	1.381

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	5.864	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.863	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.835	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.813	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.862	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	561.769	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.492	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.002	PSIA
SECONDARY BLEED FLOW RATE	=	.373	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.045	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	5.733	5.256	.117	.057	.309	.283	18.65	18.64
13	5.175	5.293	.047	.062	.279	.285	27.14	27.15
15	5.043	5.262	.030	.058	.272	.284	35.64	35.64
17	4.909	4.958	.013	.019	.265	.267	44.09	44.12
19	4.488	4.948	-.040	.018	.242	.267	52.62	52.62
21	4.708	4.836	-.013	.004	.253	.261	61.11	61.10
23	4.943	4.558	.017	.031	.266	.246	69.57	69.61
25	5.859	4.905	.133	.013	.316	.264	78.08	78.13
27	7.581	6.624	.359	.230	.409	.357	86.57	86.60
29	7.529	5.52[illegible]	.344	.091	.406	.298	95.04	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.039	-.034	.020	-30.457	-.002	.039	.032	88.988

DELP PROBE -.043

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	A1F2 TURN P1TP	MNIX,2 M12 P1YP	MAIX,2 CP11,2 P1XP	PT12 V12 P15P	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,4 TT11
[illegible]	6.122 6.197 17.933	1.374 -3.127 8.378	.664 .322 7.825	1.223 .222 7.997	18.553 1374.268 8.282	5.543 18.572 2.112	1.002 18.526 18.549	61.123 18.549 573.463
DELP PROBE -.242								
4.98	6.189 6.219 17.861	1.393 -2.742 8.181	.576 .315 7.676	1.217 .222 7.878	18.553 1387.245 8.123	5.801 18.581 1.942	1.022 18.514 18.547	62.542 18.547 573.493
9.86	6.278 6.866 17.698	1.417 -2.788 7.969	.682 .216 7.524	1.231 .234 7.665	18.512 1399.648 7.929	5.724 18.579 1.788	.998 18.512 18.545	62.789 18.545 572.823
15.77	6.348 5.946 17.582	1.421 -2.869 7.858	.602 .216 7.347	1.241 .120 7.442	18.453 1407.363 7.813	5.632 18.626 1.868	.995 18.551 18.579	62.889 18.579 573.838
19.94	6.457 6.066 17.497	1.422 -2.969 7.852	.688 .216 7.343	1.247 .106 7.372	18.357 1426.443 7.794	5.611 18.587 1.979	.989 18.532 18.559	60.080 18.559 573.493
24.96	6.546 6.375 17.464	1.439 -3.298 7.734	.601 .216 7.142	1.262 .132 7.185	18.421 1419.727 7.713	5.481 18.575 2.298	.993 18.516 18.545	61.298 18.545 573.148
30.25	6.637 5.965 17.438	1.458 -2.988 7.543	.729 .216 7.058	1.273 .255 7.299	18.498 1432.868 7.527	5.357 18.563 1.678	.997 18.524 18.534	62.888 18.534 573.838

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	A1F2 TURN P1TP	MNIX,2 M12 P1YP	MAIX,2 CP11,2 P1XP	PT12 V12 P15P	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,4 TT11
35.21	6.726 2.169 17.403	1.435 .917 7.494	.784 .218 7.081	1.180 .366 7.592	18.188 1356.278 7.631	5.573 18.542 -1.927	.980 18.538 18.558	57.983 18.552 573.148
40.21	6.815 5.457 17.337	1.226 -2.189 8.616	.642 .217 8.261	1.129 .706 8.412	17.757 1317.383 8.607	5.426 18.511 1.372	.957 18.537 18.574	60.388 18.574 573.148
44.99	6.024 6.578 17.887	1.347 -3.521 8.441	.882 .216 7.841	1.202 .268 7.826	15.486 1368.839 8.418	6.282 18.501 2.401	.996 18.536 18.563	61.591 18.563 573.493
49.97	6.003 4.747 17.146	1.290 -1.725 8.665	.644 .216 8.400	1.175 1.126 8.220	17.448 1303.578 8.781	6.473 18.553 .495	.940 18.495 18.524	59.765 18.524 573.493
55.21	7.283 3.773 14.802	.926 -.696 9.049	.465 .216 9.338	.745 3.661 9.113	14.609 975.362 9.324	8.731 18.564 -.394	.762 18.545 18.554	58.604 18.554 573.838
59.99	7.172 .086 14.991	.817 2.001 9.291	.464 .215 9.835	.663 4.463 9.265	14.891 893.355 9.378	9.154 18.606 -4.001	.759 18.537 18.571	55.009 18.571 573.493
64.97	7.261 .539 16.114	1.144 2.538 9.172	.649 .217 9.912	.942 2.361 9.323	16.162 1195.153 9.543	7.183 18.585 -3.538	.871 18.509 18.547	55.462 18.547 572.459

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PFRCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.01	7.351	1.193	.669	.988	17.583	7.314	.948	55.884
	.981	2.116	.019	.970	1235.462	18.571	18.509	18.540
	17.467	9.218	9.945	9.404	9.797	-3.116	18.540	573.838
74.99	7.440	1.219	.658	1.025	18.065	7.271	.974	57.301
	2.378	.809	.019	.488	1255.591	18.584	18.528	18.556
	17.901	9.300	9.711	9.410	9.698	-1.699	18.556	573.493
79.97	7.529	1.262	.643	1.087	18.279	6.941	.985	59.400
	4.477	-1.400	.018	.274	1290.000	18.607	18.546	18.576
	18.011	9.159	9.060	9.073	9.265	.400	18.576	574.525
85.00	7.619	1.333	.633	1.173	18.553	6.405	1.000	61.649
	6.726	-3.649	.017	.000	1343.276	18.569	18.548	18.558
	18.058	8.826	8.150	8.462	8.630	2.639	18.558	573.148
89.98	7.708	1.336	.711	1.131	18.430	6.333	.993	57.823
	2.000	.177	.017	.123	1345.766	18.578	18.528	18.553
	17.925	8.373	8.672	8.210	8.457	-1.177	18.553	574.183
94.96	7.797	1.323	.657	1.148	18.115	6.336	.976	60.222
	5.299	-2.222	.017	.438	1336.189	18.571	18.527	18.549
	17.666	8.571	8.267	8.341	8.482	1.222	18.549	573.403
100.00	7.887	1.358	.656	1.160	18.445	6.148	.994	61.290
	6.176	-3.200	.017	.108	1362.942	18.596	18.542	18.569
	17.856	8.474	7.930	8.107	8.245	2.389	18.569	572.883

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
1.288	59.268	.958

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.658	1.107	17.771	6.515	573.148	1.332	1.028

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.640	1.120	17.530	6.565	573.148	1.324	1.273	59.812

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

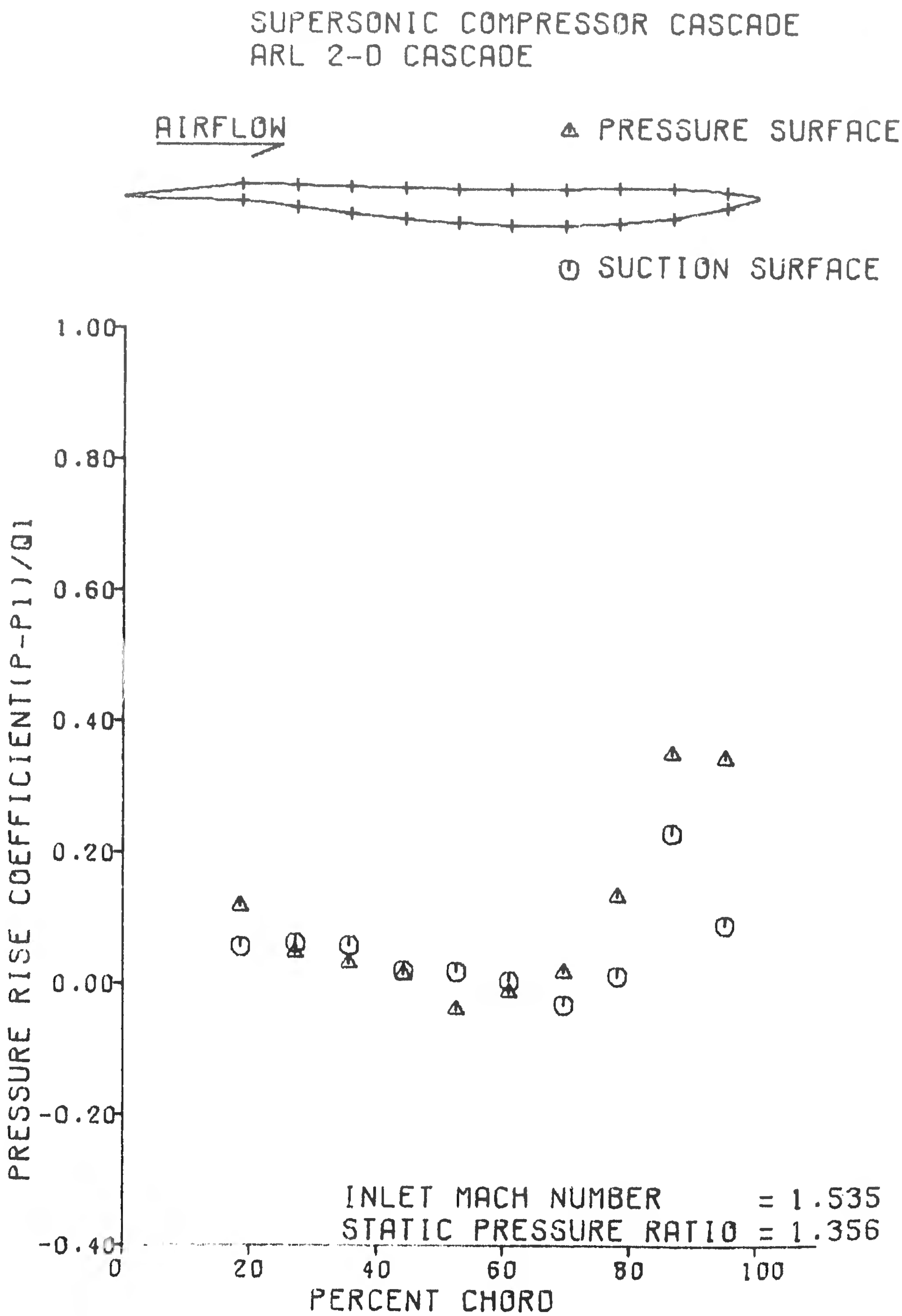
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.356	.958	.882	.851	.894	1.228	1.104	.057
.010	.147	1.291	.090	1.168	.216	4.345	-1.288
60.711	.957						

OVERALL PERFORMANCE

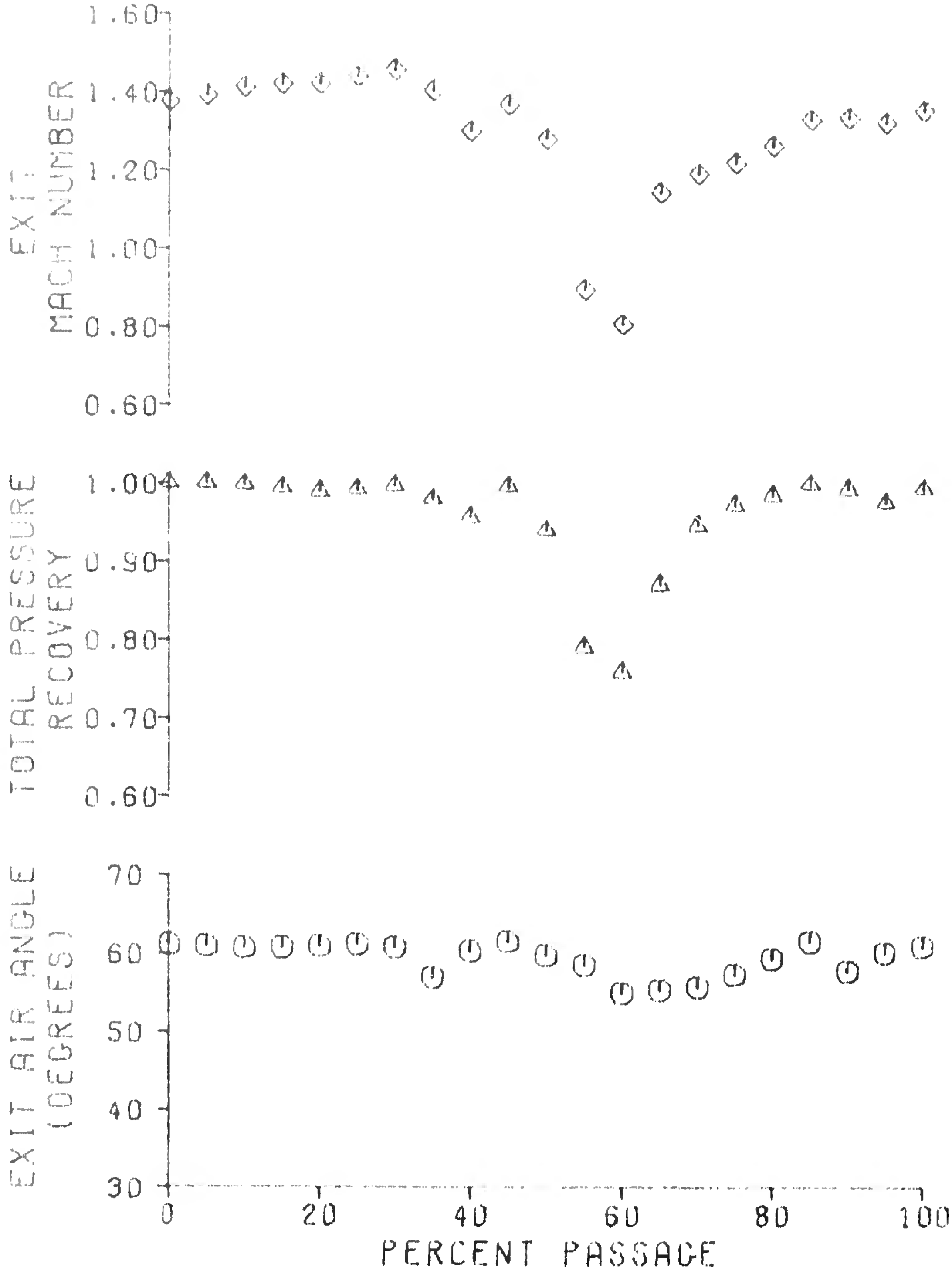
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.366	.945	.874	.829	.891	1.230	1.111	.074
.012	.156	1.304	.092	1.154	.222	4.889	-1.812
60.462	.980						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
PRESSURE RISE COEFFICIENT(P-P1)/Q1
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.535
STATIC PRESSURE RATIO = 1.356

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.535
CASCADE STATIC PRESSURE RATIO = 1.356



CASCADE SCHLIEREN

MN)1 = 1.535, P)2/P)1 = 1.356

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.535	1.432	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.577	18.565	18.576	18.591
11	17.826	4.769	5.734	5.253
13	8.629	4.822	5.174	5.292
15	8.159	4.673	5.841	5.263
17	6.234	4.782	4.988	4.961
19	8.497	4.828	4.584	4.946
21	18.519	18.552	4.770	4.835
23	6.543	5.888	5.853	4.556
25	6.952	4.999	7.595	4.985
27	7.144	4.784	8.456	6.617
29	6.942	4.837	8.851	5.522
31	6.822	4.794	18.568	18.388
33	6.636	4.688	6.448	2.173
35	6.523	4.815	6.645	5.882
37	6.784	4.771	6.484	6.944
39	6.665	5.878	7.858	4.826
41	7.446	5.864	4.485	4.885
43	4.672	1.491	3.956	5.812
45	18.534	1.586	3.763	1.479
47	18.564	18.578	18.562	18.572

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.891	1.581	38.998	31.288	573.838

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN1D	PT1D	TT1D	M1D	BETA1D
1.588	18.553	573.838	8.384	58.888

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.888	1.586
WEDGE	25	4.999	1.588
BLADE	27	4.784	1.538
BLADE	29	4.837	1.538
BLADE	31	4.794	1.536
BLADE	33	4.688	1.552
BLADE	35	4.815	1.533
BLADE	37	4.771	1.548

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.588	-.798	48.668	1.535	1.888	.962

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
56.934	2.733	1.787	.025	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	SS	ML	EXIT METAL ANGLE ML (DEG.)
50.347	53.797	52.032	34.923

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	R)1	Q)1
1.535	18.553	573.838	58.000	4.805	.325	7.922

T)SS	I)HL	MN)X,1	MN)M,1	TT/T)1	PT/P)1	KP/12***
4.203	5.960	.813	1.302	1.471	3.851	1.162

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 1	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	6.543	33	6.636
25	6.952	35	6.523
27	7.144	37	6.784
29	6.942	39	6.665
31	6.822	41	7.446

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
6.881	.158	6.811	.325	1.280	1.432

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	5.872	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.864	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.826	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.805	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	5.012	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	559.355	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.479	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.098	PSIA
SECONDARY BLEED FLOW RATE	=	.367	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.044	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	5.734	5.253	.117	.057	.309	.283	18.65	18.64
13	5.174	5.202	.247	.062	.279	.285	27.14	27.15
15	5.041	5.283	.030	.058	.272	.284	35.64	35.64
17	4.908	4.981	.013	.020	.265	.267	44.09	44.12
19	4.504	4.946	-.036	.018	.243	.267	52.62	52.62
21	4.770	4.835	-.404	.004	.257	.261	61.11	61.10
23	5.053	4.556	.031	-.031	.272	.246	69.57	69.61
25	7.595	4.985	.352	.013	.409	.264	78.08	78.13
27	8.456	6.617	.461	.229	.456	.357	86.57	86.60
29	8.051	5.522	.410	.001	.434	.298	95.04	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.074	-.063	.039	-31.586	-.002	.074	.360	81.234

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	6.100 5.733 17.840	1.375 -2.656 8.281	.674 .000 7.856	1.198 .052 7.860	18.501 1375.127 8.302	6.023 18.572 1.656	.997 18.532 18.552	60.656 18.552 573.838
4.98	6.189 5.737 17.831	1.388 -2.660 8.175	.680 .016 7.745	1.210 .000 7.747	18.553 1364.825 8.204	5.928 18.581 1.660	1.000 18.515 18.548	60.660 18.549 572.114
9.96	6.278 5.578 17.745	1.387 -2.501 8.109	.683 .015 7.725	1.207 .097 7.714	18.456 1383.700 8.219	5.910 18.584 1.491	.995 18.513 18.549	60.501 18.549 573.838
15.00	6.368 6.055 17.658	1.418 -2.978 7.936	.688 .016 7.426	1.240 .035 7.441	18.518 1406.196 7.880	5.672 18.601 1.968	.998 18.541 18.571	60.978 18.571 573.148
19.98	6.457 5.955 17.570	1.442 -2.878 7.709	.702 .015 7.225	1.259 .000 7.236	18.553 1422.752 7.703	5.496 18.575 1.868	1.000 18.550 18.563	60.878 18.563 573.838
24.96	6.546 5.855 17.521	1.451 -2.778 7.616	.708 .016 7.158	1.266 .000 7.128	18.553 1429.124 7.640	5.424 18.573 1.768	1.000 18.537 18.555	60.778 18.555 573.838
30.25	6.637 6.274 17.464	1.453 -3.197 7.635	.700 .016 7.069	1.273 .052 7.097	18.501 1430.702 7.581	5.391 18.559 2.187	.997 18.515 18.537	61.197 18.537 572.803

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
35.03	6.726 -1.371 17.415	1.297 4.448 9.057	.771 .017 9.372	1.044 .780 8.118	17.773 1317.619 8.443	6.438 18.587 -5.448	.958 18.547 18.567	53.552 18.567 573.148
40.01	6.815 4.163 17.398	1.208 -1.086 9.384	.620 .018 9.364	1.036 1.017 8.994	17.536 1247.783 9.762	7.158 18.583 .085	.945 18.531 18.557	59.086 18.557 573.148
44.99	6.904 3.400 17.859	1.183 -.323 9.831	.621 .018 9.994	1.007 .599 9.883	17.961 1228.145 10.263	7.569 18.573 -.687	.968 18.535 18.554	53.323 18.554 573.148
49.97	6.993 4.531 17.442	1.181 -1.454 9.790	.600 .018 9.687	1.017 1.014 9.640	17.539 1226.560 9.996	7.409 18.602 .444	.945 18.530 18.566	59.454 18.566 571.769
55.01	7.083 3.683 14.941	.884 -.806 9.549	.460 .016 9.614	.754 3.612 9.308	14.941 985.131 9.597	8.989 18.584 -.404	.805 18.531 18.558	58.606 18.555 573.493
59.99	7.172 .040 14.191	.828 3.037 9.219	.475 .015 9.786	.678 4.363 9.136	14.191 911.675 9.398	9.051 18.582 -4.047	.755 18.571 18.576	54.963 18.576 572.459
64.97	7.261 .207 16.057	1.151 2.070 9.024	.658 .017 9.836	.944 2.443 9.198	16.111 1201.283 9.461	7.001 18.588 -3.870	.868 18.525 18.556	55.130 18.556 572.003

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A TT)1
	7.351	1.207	.670	1.004	17.587	7.108	.948	56.290
70.01	1.367	1.710	.818	.966	1247.083	18.583	18.516	18.550
	17.449	9.102	9.737	9.257	9.540	-2.710	18.550	572.114
	7.440	1.238	.652	1.053	18.062	7.884	.974	58.221
74.99	3.298	-.221	.018	.491	1271.071	18.600	18.522	18.561
	17.056	9.194	9.384	9.222	9.407	-.779	18.561	571.769
	7.529	1.266	.623	1.101	18.225	6.899	.982	60.490
79.97	5.567	-2.490	.017	.328	1293.370	18.588	18.533	18.557
	17.949	9.335	8.868	9.031	9.161	1.400	18.557	572.803
	7.619	1.320	.607	1.172	18.374	6.452	.990	62.627
85.00	7.704	-4.627	.015	.179	1334.770	18.595	18.510	18.553
	17.928	8.983	8.066	8.554	8.630	3.617	18.553	572.455
	7.708	1.317	.688	1.123	18.245	6.434	.983	58.496
89.98	3.573	-.496	.017	.308	1332.484	18.610	18.539	18.574
	17.813	8.588	8.715	8.332	8.517	-.504	18.574	572.114
	7.757	1.300	.630	1.137	17.951	6.475	.968	61.007
94.96	6.084	-3.007	.017	.602	1319.957	18.592	18.521	18.557
	17.580	8.816	8.324	8.414	8.719	1.097	18.557	572.114
	7.887	1.336	.653	1.165	18.343	6.304	.989	60.731
100.00	5.808	-2.731	.016	.210	1340.487	18.573	18.522	18.548
	17.842	8.614	8.179	8.253	8.516	1.721	18.548	572.114

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
1.283	58.983	.954

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.651	1.082	17.798	6.720	573.838	1.319	1.834

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.632	1.075	17.475	6.773	573.838	1.311	1.247	59.535

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

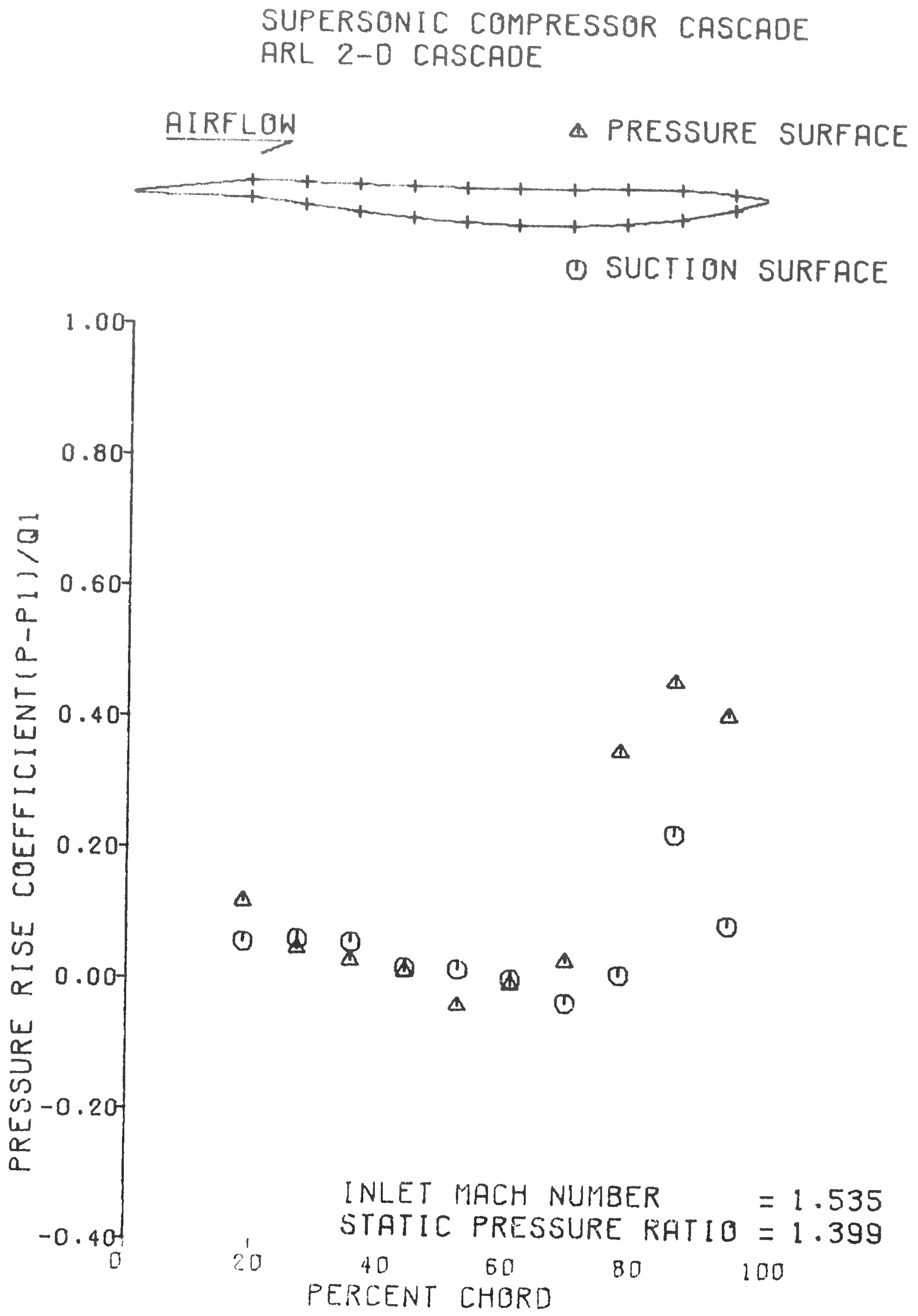
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.399	.954	.869	.845	.878	1.254	1.115	.061
.010	.165	1.314	.103	1.165	.242	4.060	-.983
60.901	.944						

OVERALL PERFORMANCE

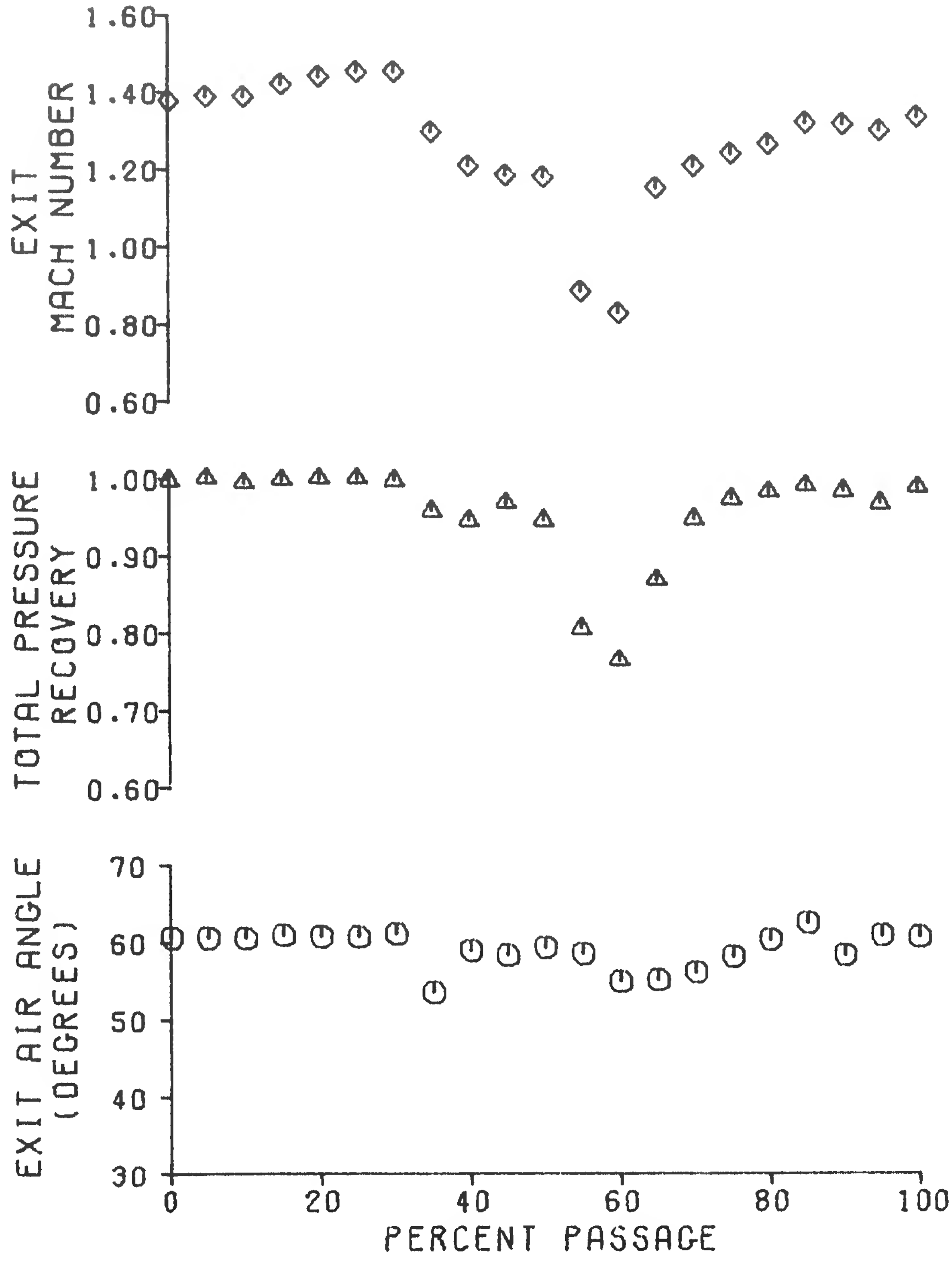
MIXED EXIT CONDITIONS

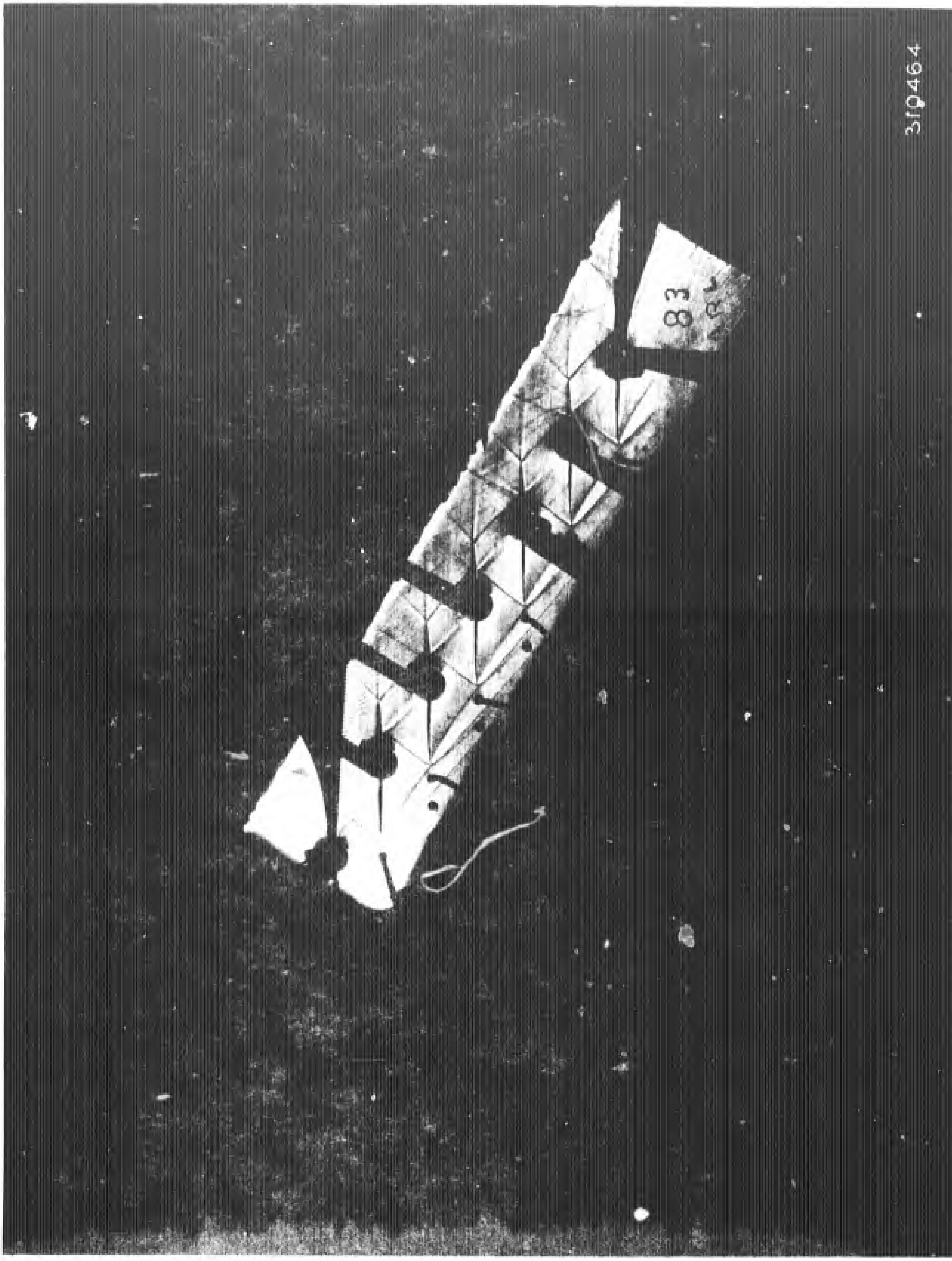
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.410	.942	.861	.824	.875	1.256	1.122	.078
.013	.174	1.327	.106	1.150	.248	4.612	-1.535
60.652	.967						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
PRESSURE RISE COEFFICIENT(P-P1)/Q1
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.535
STATIC PRESSURE RATIO = 1.399

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES, = 0.680
CASCADE INLET MACH NUMBER = 1.535
CASCADE STATIC PRESSURE RATIO = 1.399





CASCADE SCHLIEREN

MN)1 = 1.535, P)2/P)1 = 1.399

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.535	1.549	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	10.586	10.587	10.562	10.582
11	17.818	4.709	5.730	5.259
13	8.581	4.817	5.174	5.299
15	8.173	4.669	5.850	5.269
17	8.247	4.705	4.912	4.967
19	8.580	4.830	4.639	4.956
21	10.540	10.575	4.922	4.846
23	7.188	5.017	5.440	4.570
25	7.578	5.005	8.279	4.939
27	7.658	4.793	8.977	6.633
29	7.346	4.864	8.539	5.543
31	7.373	4.791	10.595	10.505
33	5.826	4.698	6.948	3.363
35	6.985	4.836	7.055	5.597
37	7.347	4.756	7.001	7.421
39	8.761	5.074	7.092	4.840
41	7.585	5.072	4.416	4.823
43	4.679	1.458	3.865	4.869
45	10.567	1.468	3.764	1.447
47	10.614	10.607	10.597	10.606

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.865	1.581	37.990	31.210	573.140

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN)0	PT)0	TT)0	M)0	BETA)0
1.588	13.580	573.140	6.321	58.790

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.017	1.586
WEDGE	25	5.005	1.588
BLADE	27	4.793	1.537
BLADE	29	4.864	1.527
BLADE	31	4.791	1.538
BLADE	33	4.698	1.551
BLADE	35	4.836	1.531
BLADE	37	4.756	1.543

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.598	-.500	40.649	1.535	1.000	.951

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
54.934	2.733	1.787	.225	1.222	1.222

INLET METAL ANGLE (DEGREES) PS	SS	ML	EXIT METAL ANGLE ML (DEG.)
52.947	53.797	52.232	54.923

CASCADE INLET CONDITIONS

MN11	PT11	TT11	BETA11	P11	M11	Q11
1.535	18.580	573.148	58.272	4.229	.328	7.933

I1SS	I1ML	MN1X,1	MN1Y,1	TT/T11	PT/P11	NR/10**6
4.203	5.948	.813	1.322	1.471	3.863	1.163

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	7.188	33	6.828
25	7.578	35	6.985
27	7.658	37	7.347
29	7.348	39	6.781
31	7.373	41	7.585

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P12/P11)
7.428	.189	7.191	.216	1.224	1.545

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	5.074	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.072	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.848	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.823	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.759	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	561.070	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.447	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.054	PSIA
SECONDARY BLEED FLOW RATE	=	.351	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.042	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	CPS/Q1 (PS)	CPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	5.732	5.256	.118	.057	.308	.283	18.65	18.64
13	5.174	5.269	.046	.062	.278	.285	27.14	27.15
15	5.058	5.260	.032	.058	.272	.284	35.64	35.54
17	4.912	4.967	.313	.228	.284	.287	44.39	44.12
19	4.630	4.954	.221	.218	.258	.287	52.62	52.62
21	4.922	4.846	.214	.208	.265	.261	61.11	61.10
23	5.448	4.577	.279	.030	.293	.248	69.57	69.61
25	8.270	4.935	.437	.216	.446	.266	78.08	78.13
27	8.977	8.833	.508	.238	.483	.357	86.57	86.88
29	8.539	5.543	.472	.093	.462	.208	95.04	95.08

FC	FC1Y	FC1X	BETA1P	CD11	CL11	MC1LE	CP1LE
.097	-.082	.251	-31.875	-.082	.008	.078	58.753

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y / DEV / PT)YP	MN)2 / TURN / P)TP	MN)X,2 / M)2 / P)BP	MN)Y,2 / DP)1,2 / P)WP	PT)2 / V)2 / P)SP	P)2 / PT)0 / BETA)P	PT)2/PT)1 / PT)0 / PT)1	BETA)2 / PT)0,A / TT)1
	6.188	1.338	.629	1.180	18.428	6.317	.992	61.944
.02	7.221	-3.944	.808	.151	1347.895	18.574	18.535	18.554
	17.918	8.805	8.857	8.196	8.567	2.944	18.554	573.838
	6.189	1.333	.621	1.180	18.239	6.293	.982	62.228
4.98	7.297	-4.228	.816	.341	1343.815	18.588	18.564	18.576
	17.750	8.805	7.994	8.151	8.582	3.218	18.576	572.803
	6.278	1.322	.605	1.175	17.997	6.388	.969	62.750
9.96	7.827	-4.752	.815	.583	1335.159	18.608	18.544	18.575
	17.555	8.881	7.949	8.195	8.439	3.740	18.576	574.528
	6.368	1.318	.598	1.175	17.826	6.274	.959	63.712
15.00	8.087	-5.212	.815	.754	1332.728	18.586	18.541	18.563
	17.399	8.858	7.869	8.129	8.413	4.010	18.563	573.493
	6.457	1.322	.602	1.176	17.823	6.245	.959	62.881
19.98	7.958	-4.881	.815	.757	1335.193	18.581	18.542	18.568
	17.385	8.828	7.873	7.908	8.436	3.871	18.562	574.872
	6.546	1.312	.614	1.159	17.878	6.352	.962	62.869
24.95	7.146	-4.869	.815	.782	1327.551	18.612	18.546	18.578
	17.473	8.794	8.039	8.174	8.657	3.859	18.578	573.838
	6.637	1.195	.668	.958	17.838	7.408	.962	58.808
30.05	1.877	2.800	.818	.742	1235.444	18.591	18.538	18.564
	17.718	9.421	10.131	9.313	9.954	-3.000	18.564	573.838

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y / DEV / PT)YP	MN)2 / TURN / P)TP	MN)X,2 / M)2 / P)BP	MN)Y,2 / CP)1,2 / P)WP	PT)2 / V)2 / P)SP	P)2 / PT)0 / BETA)P	PT)2/PT)1 / PT)0 / PT)1	BETA)2 / PT)0,A / TT)1
	6.726	1.134	.599	.963	17.749	7.965	.955	58.141
35.03	3.218	-.141	.819	.831	1186.978	18.584	18.534	18.559
	17.786	10.394	10.595	10.382	10.782	-.869	18.559	573.493
	6.815	1.147	.586	.986	18.027	7.958	.978	59.383
40.01	4.380	-1.303	.818	.553	1197.719	18.589	18.534	18.561
	17.970	10.564	10.493	10.407	10.742	.303	18.561	573.148
	6.904	1.159	.574	1.007	18.088	7.868	.973	68.315
44.99	5.392	-2.315	.818	.494	1207.198	18.595	18.533	18.564
	18.016	10.553	10.241	10.348	10.619	1.315	18.564	574.528
	6.993	1.136	.550	.995	17.190	7.692	.925	31.059
49.97	6.136	-3.059	.817	1.390	1188.869	18.599	18.558	18.574
	17.146	10.407	9.947	10.110	10.264	2.049	18.574	574.183
	7.083	.887	.397	.783	14.745	9.604	.794	68.558
55.01	5.635	-2.558	.815	3.835	890.999	18.605	18.548	18.572
	14.745	10.197	9.885	9.718	9.904	1.558	18.572	573.493
	7.172	.798	.434	.670	14.417	9.473	.776	57.041
59.99	2.118	.959	.814	4.163	882.346	18.597	18.522	18.560
	14.417	9.715	9.985	9.536	9.748	-1.969	18.560	574.183
	7.261	1.103	.606	.920	16.072	7.499	.865	56.539
64.97	1.615	1.462	.816	2.586	1160.816	18.578	18.542	18.556
	16.053	9.513	10.020	9.575	9.885	-2.472	18.556	573.838

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A TT)1
70.41	7.351 2.297 17.385	1.180 .780 9.586	.639 .818 9.917	.992 1.180 9.574	17.480 1224.994 9.876	7.368 18.596 -1.798	.936 18.545 18.571	57.228 18.571 574.872
74.99	7.440 3.833 17.845	1.213 -.756 9.518	.629 .818 9.571	1.037 .582 9.451	17.998 1258.924 9.727	7.300 18.581 -.254	.969 18.536 18.568	58.756 18.568 574.528
79.97	7.529 5.433 17.949	1.252 -2.556 9.363	.616 .817 8.982	1.090 .398 9.103	18.198 1282.861 9.388	7.082 18.588 1.5[illegible]	.979 18.523 18.555	60.556 18.555 574.183
85.00	7.619 7.531 17.898	1.306 -4.454 9.081	.604 .816 8.213	1.158 .285 8.579	18.295 1323.548 8.791	6.547 18.569 3.444	.985 18.528 18.544	62.454 18.544 573.838
89.88	7.708 4.084 17.758	1.282 -.927 8.820	.662 .817 8.838	1.098 .502 8.659	18.078 1305.339 8.973	6.683 18.593 -.073	.973 18.568 18.576	59.927 18.576 574.183
94.86	7.797 5.491 17.768	1.386 -2.414 8.799	.645 .817 8.449	1.136 .418 8.475	18.162 1323.343 8.725	6.582 18.622 1.484	.977 18.552 18.587	60.414 18.587 573.148
100.00	7.887 5.723 17.886	1.341 -2.646 8.572	.658 .817 8.156	1.169 .170 8.236	18.410 1349.878 8.491	6.278 18.587 1.636	.991 18.544 18.566	60.646 18.566 574.183

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
1.200	59.948	.945

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.601	1.039	17.555	7.240	573.148	1.288	1.017

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.585	1.032	17.374	7.292	573.148	1.282	1.186	60.484

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PERFORMANCE

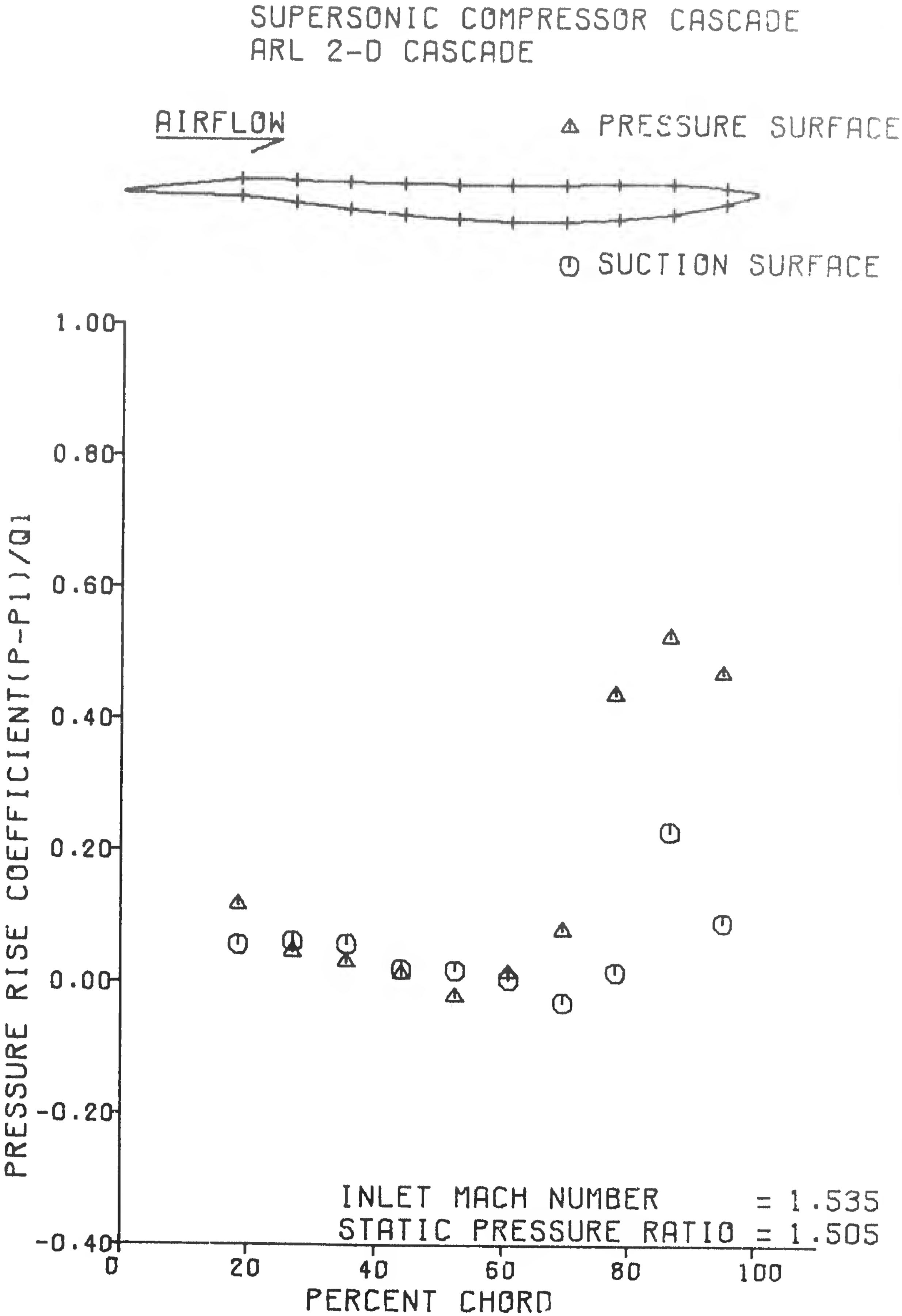
D EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
RETA)C	A)2/A)1						
1.525	.945	.835	.790	.853	1.318	1.142	.074
.012	.295	1.372	.125	1.159	.308	5.025	-1.948
61.229	.961						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

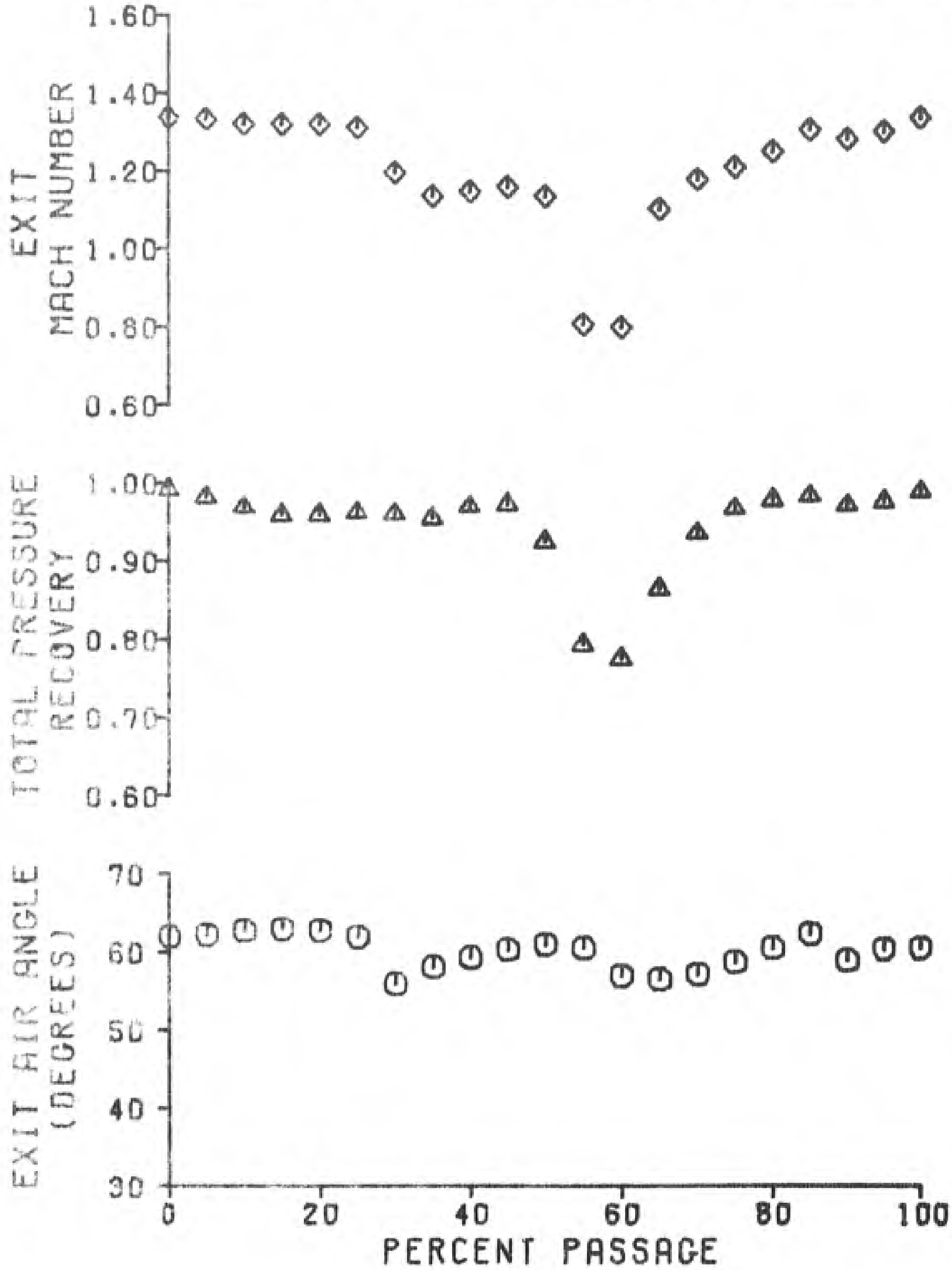
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
RETA)C	A)2/A)1						
1.516	.935	.828	.770	.830	1.321	1.148	.088
.014	.214	1.385	.127	1.147	.313	5.561	-2.484
61.016	.983						

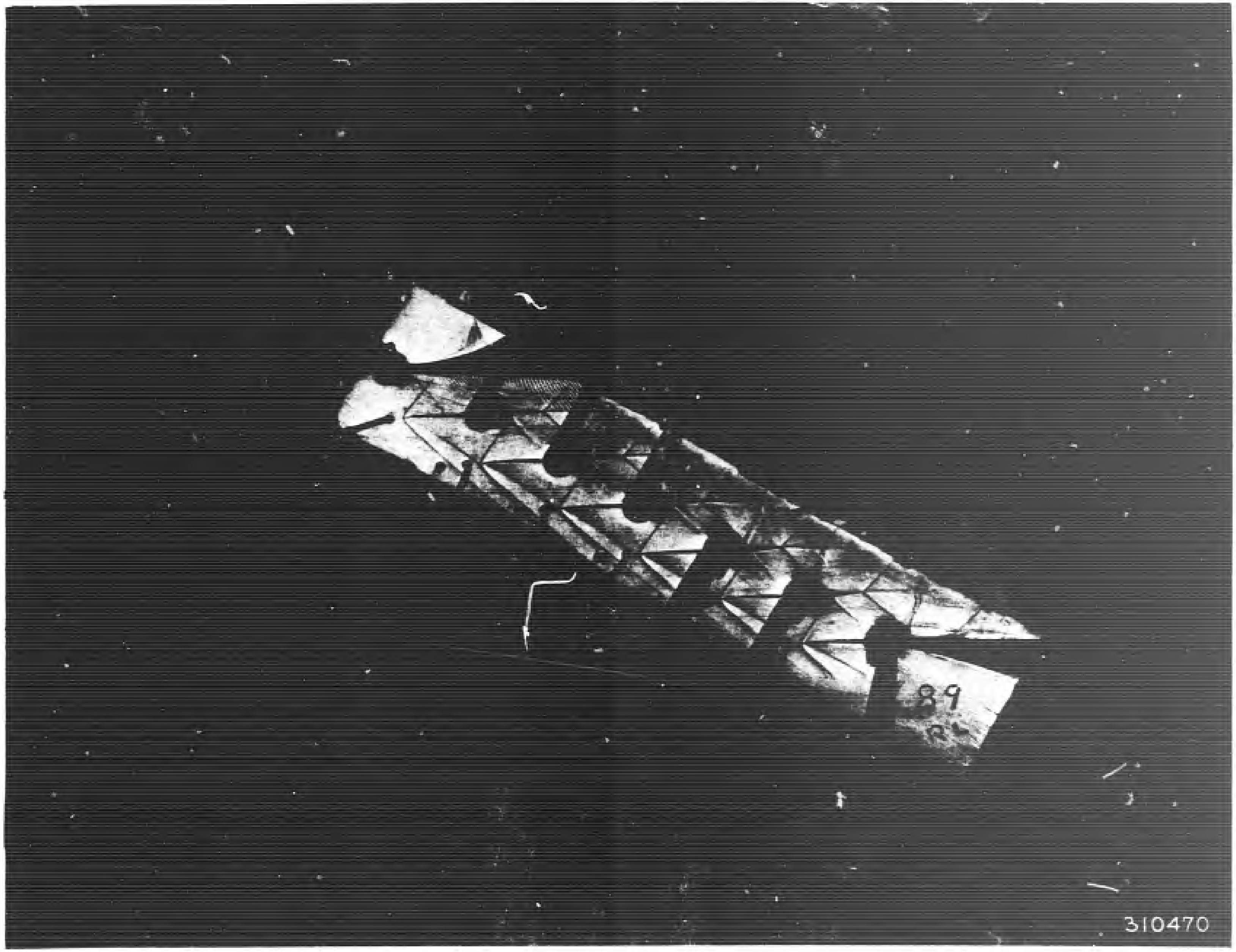


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
PRESSURE RISE COEFFICIENT(P-P1)/Q1
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.535
STATIC PRESSURE RATIO = 1.505

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.535
CASCADE STATIC PRESSURE RATIO = 1.505





CASCADE SCHLIEREN
MN)1 = 1.535, P)2/P)1 = 1.505

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.535	1.759	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	10.463	10.448	10.448	10.435
11	17.464	4.672	5.701	5.221
13	10.544	4.781	5.140	5.266
15	10.823	4.624	5.183	5.232
17	10.582	4.665	5.437	4.934
19	10.833	4.766	5.858	4.919
21	18.376	10.417	7.529	4.880
23	8.338	4.969	8.783	4.540
25	8.368	4.967	9.298	4.910
27	8.265	4.751	8.766	6.566
29	8.304	4.813	8.042	5.539
31	8.536	4.758	10.437	10.464
33	7.321	4.660	8.114	3.849
35	8.296	4.781	8.174	5.736
37	8.510	4.718	8.373	8.403
39	9.265	5.033	8.550	4.791
41	7.881	5.030	4.329	4.769
43	4.636	1.440	3.890	4.787
45	10.440	1.457	3.761	1.438
47	10.421	10.417	10.435	10.454

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.833	1.501	31.000	31.200	575.907

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN1D	PT1D	TT1D	M1D	BETA1D
1.508	10.420	575.907	0.229	50.000

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	4.969	1.587
WEDGE	25	4.967	1.587
BLADE	27	4.751	1.538
BLADE	29	4.813	1.529
BLADE	31	4.758	1.537
BLADE	33	4.660	1.551
BLADE	35	4.781	1.533
BLADE	37	4.718	1.542

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.508	-.800	40.649	1.535	1.002	.961

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
54.934	2.733	1.707	.025	1.200	1.000

INLET METAL ANGLE PS (DEGREES)	SS	ML	EXIT METAL ANGLE ML (DEG.)
50.947	53.707	52.032	54.923

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.535	18.420	575.907	58.000	4.768	.322	7.865

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
4.203	5.948	.813	1.300	1.471	3.863	1.146

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	8.338	33	7.321
25	8.358	35	8.296
27	8.265	37	8.510
29	8.304	39	8.265
31	8.536	41	7.881

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
8.362	.004	8.055	.410	1.125	1.754

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	5.033	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.030	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.791	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.769	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.787	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	561.769	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.438	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.082	PSIA
SECONDARY BLEED FLOW RATE	=	.345	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.042	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	5.701	5.221	.119	.058	.309	.283	18.65	18.64
13	5.140	5.266	.047	.063	.279	.286	27.14	27.15
15	5.183	5.232	.053	.059	.281	.284	35.64	35.6-
17	5.437	4.934	.085	.021	.295	.268	44.09	44.12
19	5.858	4.919	.139	.019	.318	.267	52.62	52.62
21	7.529	4.800	.351	.004	.409	.261	61.11	61.10
23	8.783	4.540	.510	-.029	.477	.246	69.57	69.61
25	9.298	4.910	.576	.018	.505	.267	78.08	78.13
27	8.766	6.566	.508	.229	.476	.356	86.57	86.60
29	8.042	5.539	.416	.098	.437	.301	95.04	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.189	-.160	.102	-32.433	-.002	.189	.135	71.495

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	6.100 3.644 17.537	1.053 -.567 10.707	.549 .000 10.803	.898 .880 10.599	17.540 1120.627 10.910	8.701 18.446 -.443	.952 18.397 18.422	58.567 18.422 576.597
4.98	6.199 3.587 17.496	1.053 -.510 10.695	.550 .018 10.803	.898 .921 10.606	17.500 1120.627 10.916	8.681 18.461 -.500	.950 18.403 18.432	58.510 18.432 576.252
9.96	6.278 3.436 17.521	1.086 -.359 10.806	.570 .018 10.750	.925 .887 10.526	17.533 1149.074 10.879	8.355 18.457 -.651	.952 18.404 18.430	58.359 18.430 575.907
15.00	6.368 3.384 17.545	1.110 -.307 10.511	.583 .018 10.670	.944 .851 10.430	17.570 1169.220 10.802	8.131 18.444 -.703	.954 18.389 18.417	58.307 18.417 575.907
19.98	6.457 3.503 17.574	1.119 -.426 10.472	.586 .018 10.605	.953 .816 10.374	17.635 1177.228 10.744	8.051 18.420 -.584	.956 18.394 18.407	58.426 18.407 575.562
24.96	6.546 3.622 17.647	1.127 -.545 10.452	.588 .018 10.558	.961 .737 10.353	17.683 1183.431 10.722	8.012 18.442 -.465	.960 18.411 18.427	58.545 18.427 575.562
30.05	6.637 4.173 17.869	1.149 -1.096 10.457	.590 .018 10.437	.986 .494 10.332	17.927 1201.954 10.661	7.897 18.467 .086	.973 18.420 18.443	59.096 18.443 575.907

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
35.03	6.726 4.939 17.844	1.157 -1.862 10.430	.581 .018 10.227	1.001 .509 10.246	17.911 1208.807 10.525	7.807 18.435 .862	.972 18.384 18.409	59.862 18.409 575.907
40.01	6.815 5.743 17.477	1.154 -2.666 10.358	.566 .017 9.976	1.026 .880 10.298	17.540 1205.712 10.244	7.671 18.411 1.656	.952 18.363 18.387	60.666 18.387 575.907
44.99	6.904 6.035 16.553	1.115 -2.958 10.207	.541 .016 9.788	.974 1.841 9.926	16.579 1173.454 9.977	7.625 18.458 1.958	.900 18.414 18.436	60.958 18.436 575.907
49.97	6.993 5.680 15.023	.851 -2.603 9.088	.418 .015 9.744	.741 3.397 9.675	15.023 935.420 9.758	9.359 18.481 1.593	.816 18.424 18.452	60.603 18.452 576.252
55.21	7.083 3.130 14.534	.815 -.253 9.728	.431 .015 9.863	.691 3.886 9.521	14.534 980.265 9.587	9.397 18.451 -.957	.789 18.402 18.427	58.053 18.427 575.907
59.99	7.172 1.555 15.559	.916 1.522 9.543	.506 .016 9.975	.764 2.861 9.561	15.559 997.130 9.756	9.040 18.437 -2.532	.845 18.375 18.406	56.478 18.406 576.597
64.97	7.251 2.280 16.868	1.163 .817 9.546	.630 .017 9.952	.978 1.481 9.620	16.939 1213.918 9.871	7.325 18.437 -1.827	.920 18.390 18.413	57.183 18.413 576.252

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV T)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)RP	MN)Y,2 CP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)C PT)1	BETA)2 PT)C,A TT)1
	7.351	1.184	.626	1.005	17.547	7.388	.953	58.091
72.01	3.168	-.001	.018	.873	1230.842	18.459	18.380	18.424
	17.446	9.604	9.818	9.612	9.886	-.919	18.424	575.907
	7.440	1.203	.609	1.037	17.758	7.298	.964	59.574
74.90	4.851	-1.574	.018	.662	1245.940	18.449	18.395	18.422
	17.626	9.502	9.466	9.436	9.717	.574	18.422	576.252
	7.529	1.226	.598	1.070	17.849	7.114	.969	60.779
79.97	5.856	-2.779	.017	.571	1264.491	18.433	18.369	18.401
	17.671	9.526	9.101	9.209	9.482	1.769	18.401	575.907
	7.619	1.211	.517	1.042	17.795	7.236	.966	59.349
85.00	4.426	-1.349	.017	.625	1252.417	18.433	18.406	18.420
	17.647	9.593	9.510	9.293	9.521	.349	18.420	575.562
	7.708	1.163	.618	.986	17.636	7.627	.957	57.931
89.98	3.078	.069	.018	.784	1213.918	18.442	18.423	18.423
	17.563	10.013	10.263	9.966	10.250	-1.079	18.423	575.907
	7.707	1.113	.598	.939	17.542	8.083	.952	57.531
94.96	2.608	.469	.018	.878	1172.160	18.464	18.413	18.438
	17.516	10.372	10.703	10.390	10.670	-1.469	18.438	576.252
	7.887	1.053	.559	.892	17.481	8.672	.949	57.943
100.00	3.020	.057	.019	.939	1120.627	18.439	18.387	18.413
	17.478	10.593	10.821	10.581	10.828	-1.057	18.413	574.525

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

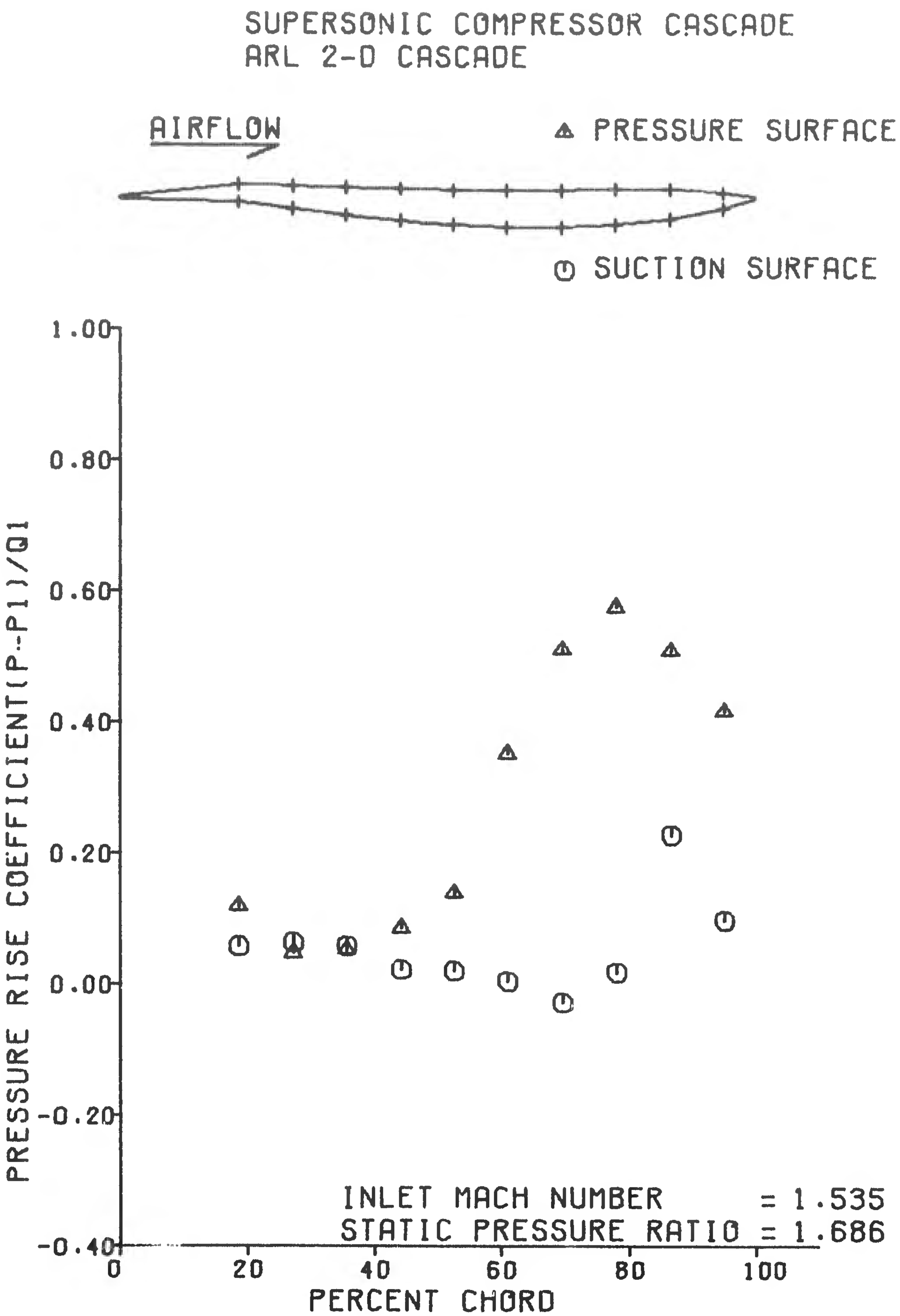
MN)2	BETA)2	PT)2/PT)1
1.102	58.709	.935

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.571	.943	17.228	8.040	575.907	1.243	1.875

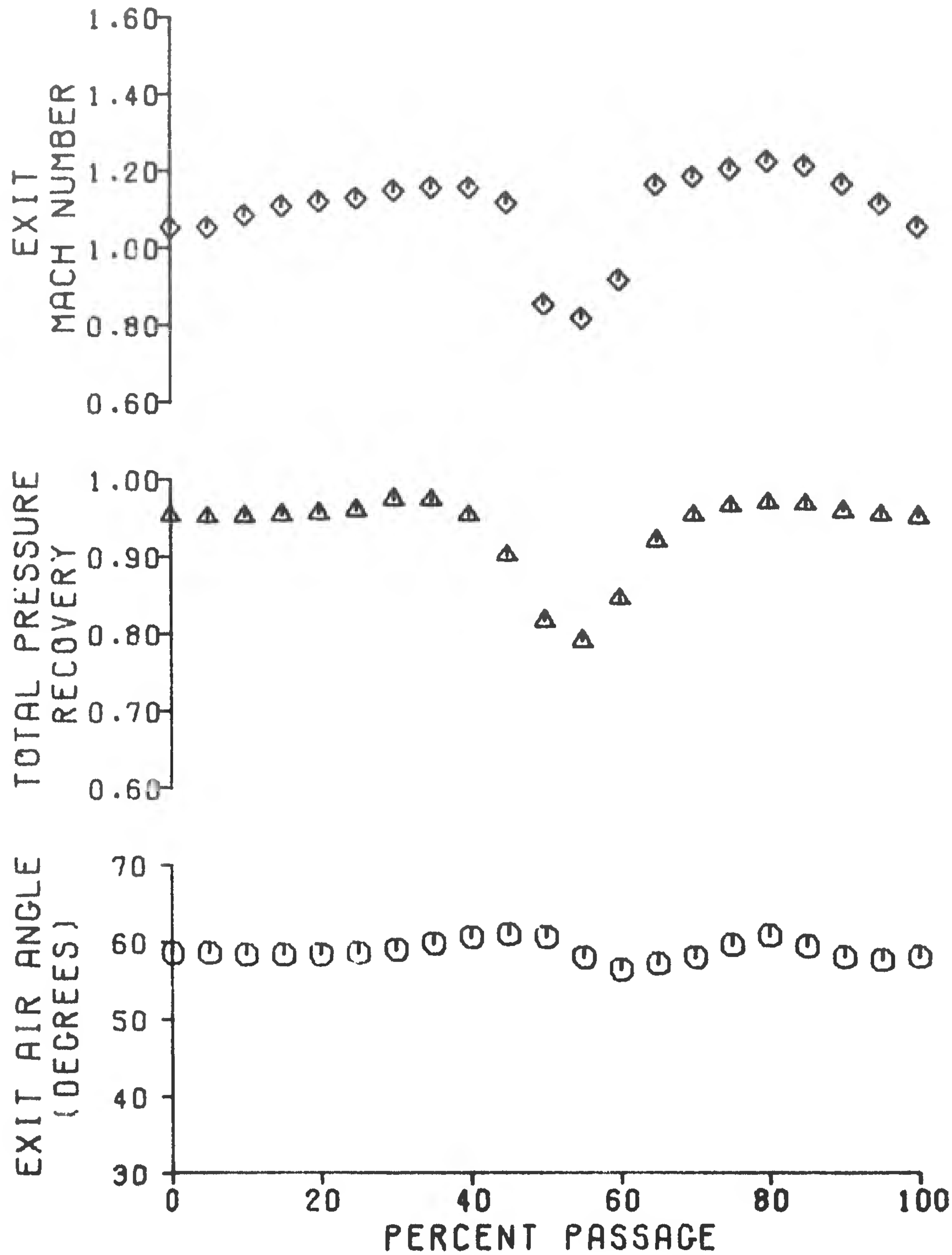
MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.562	.940	17.156	8.086	575.907	1.240	1.095	59.142


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
PRESSURE RISE COEFFICIENT(P-P1)/Q1
INLET MACH NUMBER = 1.535
STATIC PRESSURE RATIO = 1.686
0
20
40
60
80
100
PERCENT CHORD

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.535
CASCADE STATIC PRESSURE RATIO = 1.686



SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

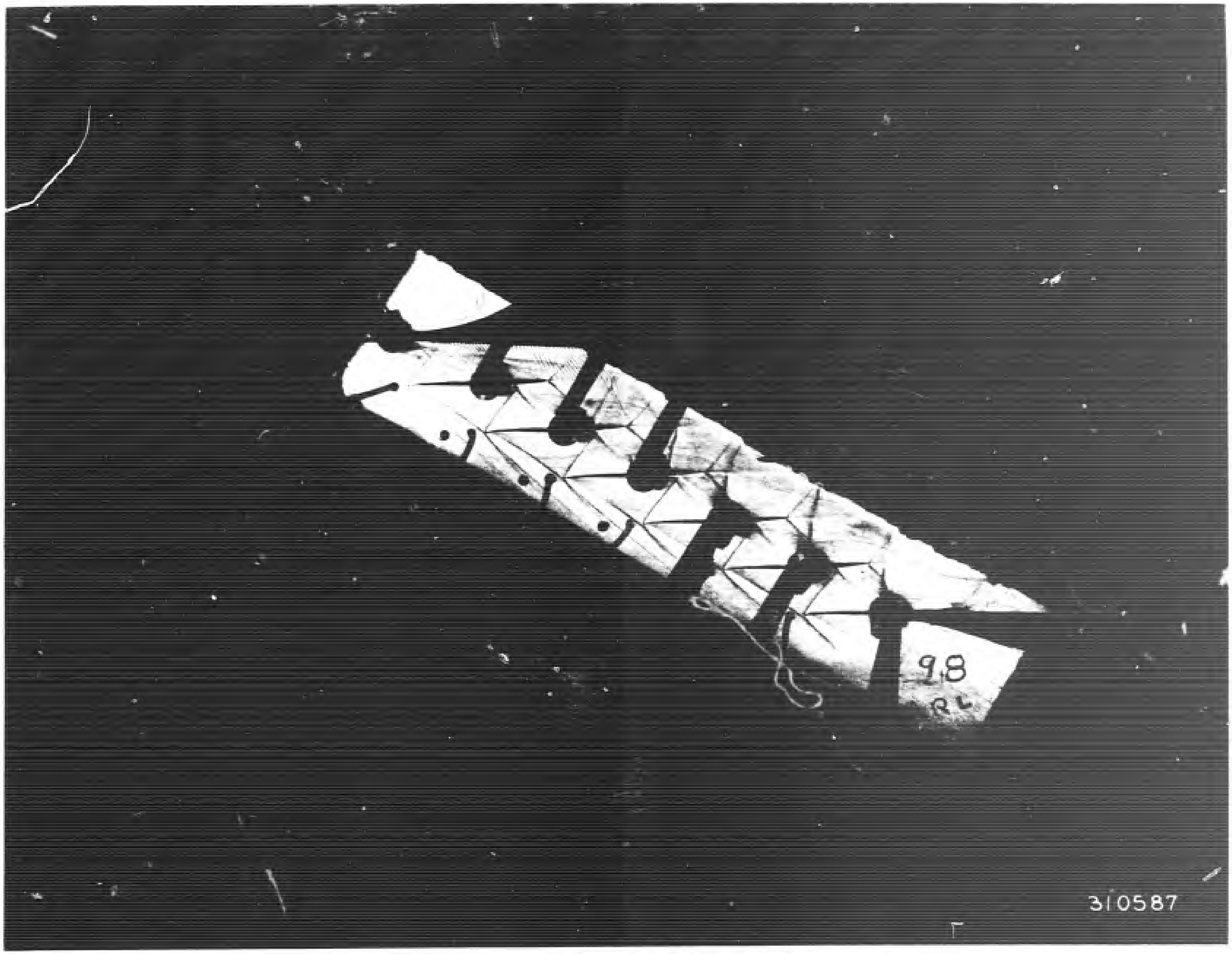
MASS AVERAGED EXIT CONDITIONS

P)2/P)1 TPLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
1.686	.935	.782	.764	.788	1.425	1.183	.087
.015	.277	1.482	.180	1.125	.416	3.866	-.789
61.585	.918						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P)2/P)1 TPLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
1.696	.931	.777	.752	.786	1.429	1.187	.093
.016	.282	1.491	.181	1.119	.422	4.217	-1.140
61.493	.930						



CASCADE SCHLIEREN

MN)1 = 1.535, P)2/P)1 = 1.686

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.535	2.041	3	.600

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.423	18.428	18.406	18.427
11	17.407	4.667	8.279	5.230
13	10.500	4.780	8.221	5.427
15	11.121	4.571	7.721	5.645
17	13.618	4.660	8.865	5.241
19	10.834	4.703	10.034	5.839
21	18.369	18.405	10.059	6.348
23	9.642	4.966	9.730	8.124
25	9.681	4.959	9.420	8.547
27	9.719	5.701	8.698	7.893
29	9.770	4.891	9.190	8.698
31	9.775	5.201	18.410	18.427
33	9.676	5.069	9.686	3.483
35	9.654	6.660	9.761	7.924
37	9.749	6.961	9.994	10.097
39	9.653	5.029	10.189	4.640
41	9.744	5.020	4.273	4.325
43	4.580	1.666	3.729	4.705
45	18.423	1.682	3.599	1.658
47	18.450	18.432	18.433	18.455

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.880	1.502	31.000	31.200	575.907

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN)0	PT)0	TT)0	M)0	BETA)0
1.508	18.414	575.907	8.227	58.000

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	4.966	1.507
WEDGE	25	4.959	1.508
BLADE	27	5.701	1.411
BLADE	29	4.891	1.517
BLADE	31	5.201	1.475
BLADE	33	5.069	1.493
BLADE	35	6.660	1.290
BLADE	37	6.961	1.266

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.508	-.000	40.649	1.535	1.000	.961

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
58.934	2.733	1.787	.025	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	SS	ML	EXIT METAL ANGLE ML (DEG.)
50.947	53.797	52.032	54.923

CASCADE INLET CONDITIONS

MN11	PT11	TT11	BETA11	P11	M11	D11
1.535	18.414	575.007	58.000	4.766	.322	7.862

I1SS	I1ML	MN1X,1	MN1Y,1	TT/T11	PT/P11	NR/10**6
4.293	5.968	.813	1.302	1.471	3.863	1.146

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.642	33	9.676
25	9.681	35	9.654
27	9.719	37	9.749
29	9.770	39	9.653
31	9.775	41	9.744

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P12/P11)
9.717	.051	9.695	.042	1.881	2.039

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	5.029	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.020	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.640	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.325	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.705	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	562.459	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.698	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.120	PSIA
SECONDARY BLEED FLOW RATE	=	.453	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.055	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DFS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.279	5.230	.447	.259	.452	.284	18.55	18.44
13	8.221	5.427	.439	.064	.446	.295	27.14	27.15
15	7.721	5.645	.376	.112	.419	.307	35.64	35.64
17	8.865	5.241	.521	.060	.481	.285	44.09	44.12
19	10.034	5.039	.670	.035	.545	.274	52.62	52.62
21	10.059	5.348	.673	.201	.546	.345	61.11	61.10
23	9.730	8.124	.531	.427	.528	.441	69.57	69.61
25	9.420	8.547	.592	.481	.512	.464	78.08	78.13
27	8.698	7.893	.500	.398	.472	.429	86.57	86.60
29	9.190	8.698	.563	.500	.499	.472	95.04	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.278	-.235	.146	-31.663	-.007	.278	.124	44.671

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y / DEV / PT)YP	MN)2 / TURN / P)TP	MN)X,2 / M)2 / P)RP	MN)Y,2 / DP)1,2 / P)NP	PT)2 / V)2 / P)SP	P)2 / PT)0 / BETA)P	PT)2/PT)1 / PT)0 / PT)1	BETA)2 / PT)0,A / TT)1
	6.100	.919	.509	.765	17.243	9.987	.936	56.350
.00	1.427	1.650	.000	1.171	999.768	18.431	18.395	18.413
	17.243	10.509	11.016	10.594	10.844	-2.660	18.413	575.907
	6.189	.929	.517	.771	17.404	9.972	.945	56.182
4.98	1.259	1.818	.019	1.010	1008.788	18.444	18.391	18.417
	17.404	10.520	11.065	10.643	10.855	-2.818	18.417	576.597
	6.278	1.030	.568	.859	17.533	8.937	.952	56.523
9.96	1.600	1.477	.019	.881	1100.769	18.439	18.386	18.412
	17.533	10.556	11.084	10.649	10.878	-2.477	18.412	575.562
	6.368	1.053	.576	.881	17.648	8.755	.958	56.837
15.00	1.014	1.163	.019	.766	1120.827	18.429	18.378	18.403
	17.645	10.582	11.056	10.659	10.889	-2.173	18.403	576.597
	6.457	1.076	.585	.982	17.653	8.519	.959	57.029
19.98	2.106	.971	.019	.761	1140.278	18.440	18.401	18.420
	17.645	10.578	11.015	10.638	10.897	-1.971	18.420	574.872
	6.546	1.108	.595	.934	17.823	8.288	.968	57.513
24.96	2.590	.487	.019	.591	1167.567	18.440	18.415	18.425
	17.799	10.508	10.937	10.644	10.885	-1.487	18.428	575.907
	6.637	1.127	.593	.958	17.900	8.110	.972	58.214
30.05	3.201	-.214	.019	.514	1183.431	18.478	18.386	18.432
	17.863	10.592	10.774	10.574	10.813	-.786	18.432	576.252

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y / DEV / PT)YP	MN)2 / TURN / P)TP	MN)X,2 / M)2 / P)RP	MN)Y,2 / DP)1,2 / P)NP	PT)2 / V)2 / P)SP	P)2 / PT)0 / BETA)P	PT)2/PT)1 / PT)0 / PT)1	BETA)2 / PT)0,A / TT)1
	6.726	1.140	.582	.980	17.862	7.961	.970	59.282
35.23	4.359	-1.282	.018	.552	1194.367	18.444	18.380	18.412
	17.813	10.555	10.492	10.481	10.702	.272	18.412	575.907
	6.815	1.116	.555	.969	17.257	7.921	.937	60.195
40.01	5.272	-2.195	.017	1.157	1174.814	18.443	18.377	18.410
	17.229	10.485	10.218	10.302	10.491	1.195	18.410	575.907
	6.904	.812	.406	.703	15.282	9.907	.830	60.035
44.99	5.112	-2.035	.015	3.132	897.745	18.437	18.413	18.425
	15.282	10.346	10.192	10.101	10.225	1.035	18.425	575.217
	6.993	.744	.405	.623	14.367	9.953	.780	56.979
49.97	2.856	1.021	.015	4.047	830.014	18.464	18.405	18.435
	14.367	10.111	10.363	9.976	10.126	-2.021	18.435	575.907
	7.083	.882	.462	.656	15.146	9.913	.823	54.854
55.01	-.869	3.146	.016	3.268	888.383	18.425	18.395	18.410
	15.146	9.971	10.572	10.011	10.258	-4.156	18.410	575.907
	7.172	.906	.515	.745	16.458	9.668	.894	55.330
59.99	.407	2.670	.017	1.956	987.749	18.397	18.389	18.393
	16.458	10.086	10.663	10.162	10.458	-3.670	18.393	576.252
	7.261	.906	.510	.748	16.675	9.795	.906	55.704
64.97	.781	2.296	.018	1.739	987.749	18.451	18.402	18.426
	16.675	10.154	10.754	10.296	10.580	-3.306	18.426	575.562

SUPERSONIC COMPRESSOR CA
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)MP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A TT)1
70.01	7.351 .957 16.720	.906 2.120 10.263	.508 .019 10.832	.750 1.694 10.374	16.720 987.749 10.648	9.821 18.429 -3.130	.908 18.399 18.414	55.880 18.414 575.907
74.99	7.440 1.005 16.839	.906 1.992 10.328	.507 .018 10.878	.751 1.575 10.434	16.839 987.749 10.684	9.892 18.451 -3.082	.914 18.373 18.412	56.008 18.412 576.597
79.97	7.529 .903 16.868	.895 2.094 10.362	.502 .010 10.925	.741 1.546 10.472	16.868 977.704 10.745	10.024 18.418 -3.104	.918 18.379 18.399	55.906 18.399 575.562
85.00	7.619 .829 17.000	.906 2.248 10.414	.510 .019 11.017	.749 1.414 10.542	17.000 987.749 10.781	9.986 18.444 -3.258	.923 18.406 18.425	55.752 18.425 575.562
89.98	7.708 .907 17.163	.915 2.090 10.455	.513 .019 11.040	.758 1.251 10.592	17.163 996.334 10.791	9.981 18.445 -3.100	.932 18.391 18.418	55.910 18.418 575.562
94.96	7.797 .850 17.236	.915 2.218 10.508	.515 .019 11.115	.757 1.178 10.608	17.236 996.334 10.817	10.024 18.452 -3.218	.936 18.391 18.422	55.782 18.422 576.597
100.00	7.887 .845 17.415	.928 2.232 10.450	.522 .019 11.116	.768 .999 10.652	17.415 1008.701 10.848	9.980 18.429 -3.232	.946 18.395 18.412	55.768 18.412 576.597

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
.960	56.746	.921

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.526	.802	16.966	9.380	575.907	1.184	1.125

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.517	.800	16.868	9.400	575.907	1.182	.953	57.107

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

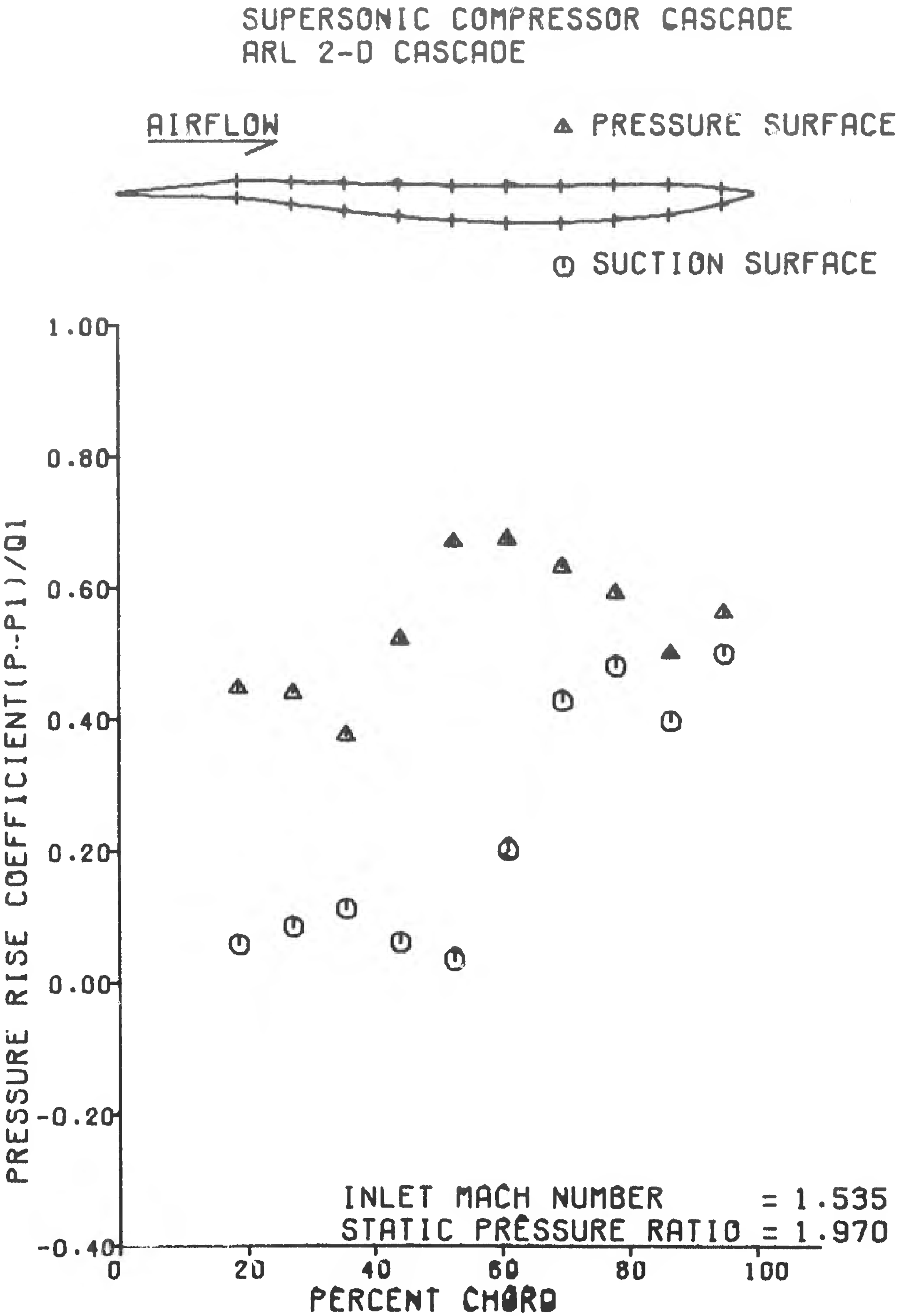
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.970	.921	.697	.721	.687	1.585	1.242	.106
.019	.390	1.688	.265	1.076	.588	1.823	1.254
61.335	.875						

OVERALL PERFORMANCE

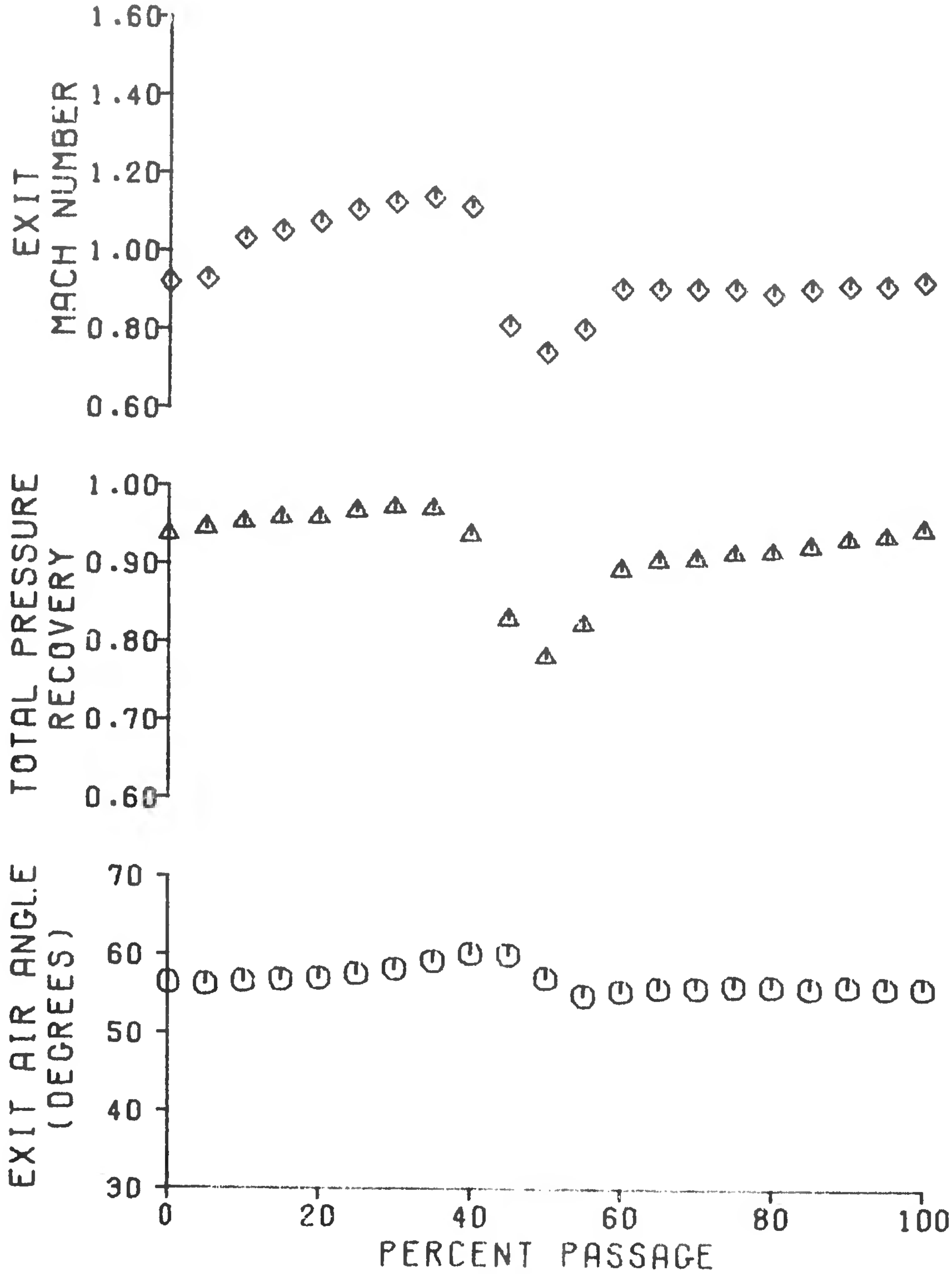
MIXED EXIT CONDITIONS

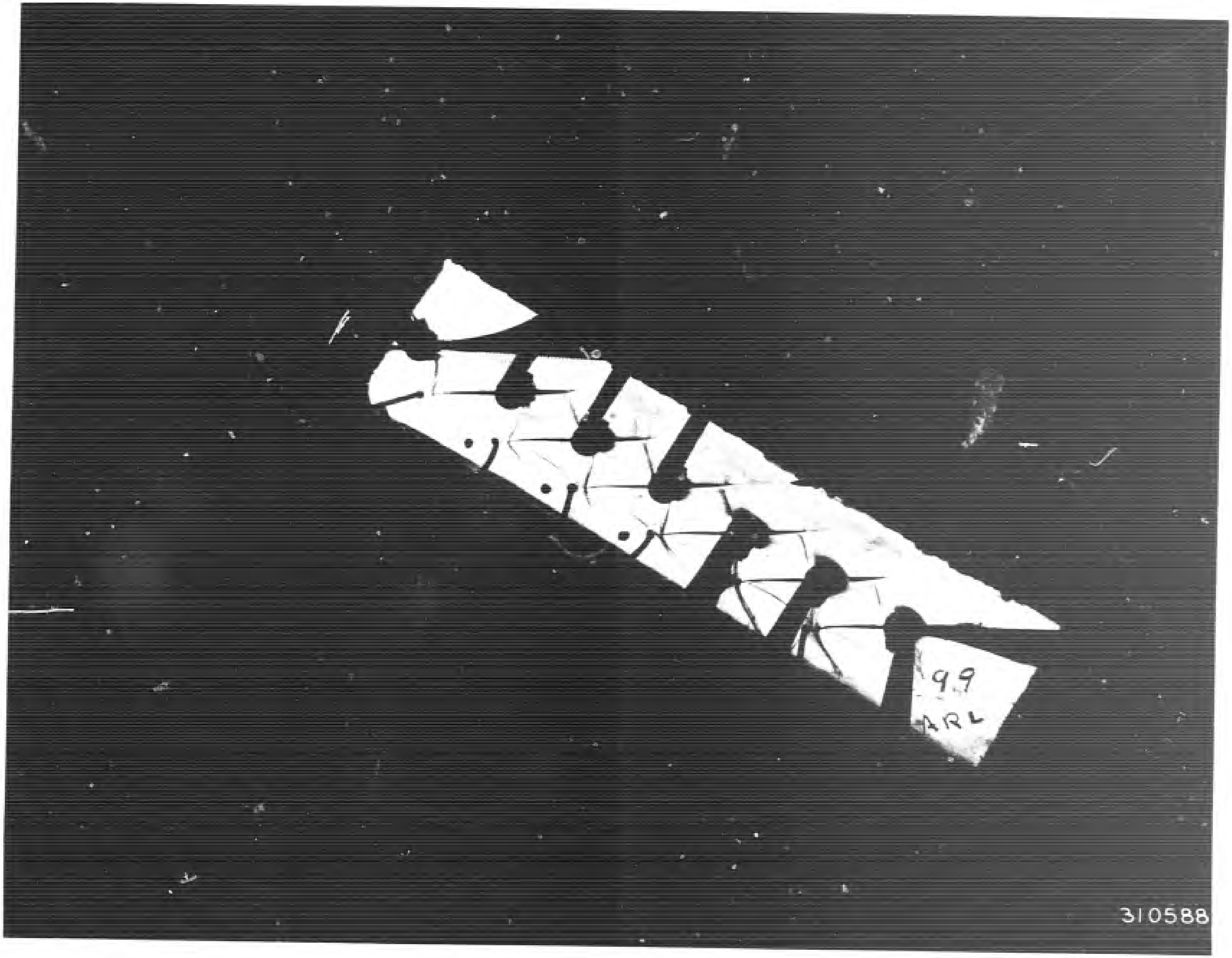
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.974	.916	.693	.710	.686	1.585	1.245	.113
.020	.395	1.699	.267	1.007	.590	2.184	.893
61.136	.889						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
PRESSURE RISE COEFFICIENT(P-P1)/Q1
INLET MACH NUMBER = 1.535
STATIC PRESSURE RATIO = 1.970
0
20
40
60
80
100
PERCENT CHORD

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES, = 0.680
CASCADE INLET MACH NUMBER = 1.535
CASCADE STATIC PRESSURE RATIO = 1.970





CASCADE SCHLIEREN

MN)1 = 1.535, P)2/P)1 = 1.970

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.535	2.040	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.448	18.434	18.440	18.440
11	17.232	4.672	8.343	5.255
13	13.454	4.799	8.098	5.589
15	11.046	4.642	7.556	5.812
17	10.575	4.661	8.614	5.276
19	10.783	4.802	10.046	5.022
21	18.385	18.408	10.048	6.669
23	9.627	4.978	9.704	8.233
25	9.670	4.963	9.399	8.478
27	9.719	6.185	8.693	7.765
29	9.754	5.419	9.179	8.583
31	9.749	5.758	10.400	18.421
33	9.660	5.129	9.631	3.520
35	9.650	6.580	9.716	8.283
37	9.734	6.978	9.916	10.044
39	9.610	5.028	10.104	4.664
41	9.642	5.021	4.299	4.417
43	4.660	1.648	3.763	4.948
45	15.404	1.656	3.619	1.642
47	18.444	18.441	18.439	18.432

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.888	1.501	31.000	31.200	575.997

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

PNJO	PTJO	TTJC	MJO	BETAJO
1.506	18.426	575.997	0.232	50.000

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	4.978	1.500
WEDGE	25	4.963	1.508
BLADE	27	6.185	1.353
BLADE	29	5.419	1.447
BLADE	31	5.758	1.404
BLADE	33	5.129	1.485
BLADE	35	6.580	1.388
BLADE	37	6.978	1.264

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	-.800	40.649	1.535	1.000	.961

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
50.934	2.733	1.797	.025	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	SS	ML	EXIT METAL ANGLE ML (DEG.)
50.947	53.797	52.032	54.923

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.535	18.426	575.907	58.000	4.789	.322	7.867

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
4.203	5.968	.813	1.309	1.471	3.863	1.147

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.627	33	9.668
25	9.670	35	9.650
27	9.719	37	9.734
29	9.754	39	9.618
31	9.749	41	9.642

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
9.704	.049	9.659	.041	1.003	2.035

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	5.028	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.021	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.664	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.417	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.940	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	563.838	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.642	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.121	PSIA
SECONDARY BLEED FLOW RATE	=	.442	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.054	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.343	5.255	.454	.062	.453	.285	18.65	18.64
13	8.098	5.509	.423	.094	.440	.299	27.14	27.15
15	7.556	5.812	.354	.133	.410	.315	35.64	35.64
17	8.614	5.276	.489	.064	.467	.286	44.09	44.12
19	10.046	5.022	.671	.032	.545	.273	52.62	52.62
21	10.048	6.669	.671	.241	.545	.362	61.11	61.10
23	9.704	8.233	.627	.440	.527	.447	69.57	69.61
25	9.399	8.478	.588	.471	.510	.460	78.08	78.13
27	8.693	7.765	.499	.381	.472	.421	86.57	86.60
29	9.179	8.583	.561	.485	.498	.466	95.84	95.86

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.267	-.227	.141	-31.786	-.006	.267	.128	44.952

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	6.188 1.388 16.876	.908 1.689 10.399	.583 .000 10.895	.754 1.549 10.502	16.876 987.749 10.707	9.914 18.433 -2.689	.918 18.395 18.414	56.311 18.414 575.217
4.98	6.189 1.156 16.993	.906 1.921 10.404	.506 .018 18.944	.752 1.433 10.518	16.993 987.749 10.722	9.982 18.432 -2.921	.922 10.378 18.401	56.879 18.401 575.907
9.96	6.278 1.403 17.183	.928 1.674 10.443	.514 .019 10.953	.772 1.243 10.554	17.183 1008.160 10.764	9.853 18.442 -2.674	.933 18.403 10.423	56.326 18.423 575.907
15.00	6.368 1.652 17.319	.933 1.425 10.461	.514 .019 10.932	.779 1.107 10.568	17.319 1012.944 10.792	9.875 18.437 -2.435	.940 18.413 18.425	56.575 18.425 576.252
19.98	6.457 2.155 17.374	1.053 .922 10.476	.572 .019 10.889	.884 1.049 10.552	17.377 1120.627 10.782	8.620 18.430 -1.922	.943 10.385 18.407	57.078 18.407 575.562
24.96	6.546 2.534 17.436	1.087 .543 18.464	.585 .018 10.804	.916 .977 10.531	17.448 1149.688 10.745	8.308 18.418 -1.543	.947 18.382 18.400	57.457 18.400 575.217
30.05	6.637 3.427 17.505	1.111 -.350 10.484	.583 .019 10.633	.946 .895 10.473	17.538 1170.547 10.693	8.097 18.426 -.660	.951 18.404 18.415	58.350 18.415 574.183

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
35.03	6.726 4.398 17.465	1.127 -1.319 10.452	.575 .018 18.379	.969 .924 10.383	17.501 1183.431 10.598	7.930 18.462 .319	.958 18.399 18.431	59.319 18.431 574.528
40.01	6.815 5.296 16.604	.929 -2.219 10.386	.481 .017 10.158	.806 1.821 10.209	16.634 1008.953 10.359	9.513 18.409 1.229	.901 18.391 18.400	60.219 18.400 575.562
44.99	6.904 4.430 14.766	.780 -1.353 10.219	.398 .015 10.170	.671 3.659 10.003	14.766 866.387 10.105	9.880 18.424 .353	.801 18.358 18.391	59.353 18.391 575.562
49.97	6.993 .975 14.251	.740 2.102 9.987	.415 .014 10.360	.612 4.175 9.922	14.251 825.912 10.074	9.910 18.418 -3.102	.773 18.378 18.398	55.898 18.398 576.941
55.01	7.083 -.011 15.476	.835 3.088 9.978	.480 .016 10.558	.683 2.950 10.023	15.476 919.883 10.240	9.803 18.463 -4.085	.840 18.405 18.434	54.912 18.434 575.562
59.99	7.172 .521 16.430	.986 2.556 10.000	.514 .018 10.638	.746 1.996 10.162	16.430 987.749 10.404	9.651 18.444 -3.566	.892 18.424 18.424	55.444 18.424 575.217
64.97	7.261 .732 16.487	.895 2.345 10.119	.505 .018 10.712	.739 1.938 10.263	16.487 977.704 10.509	9.798 18.441 -3.345	.895 18.423 18.422	55.655 18.422 575.562

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.01	7.351 .955 16.543	.894 2.122 10.212	.502 .018 10.767	.740 1.502 10.319	16.543 976.563 10.549	9.844 18.426 -3.122	.898 18.366 18.396	55.878 18.395 575.217
74.99	7.440 .827 16.702	.895 2.250 10.278	.504 .018 10.863	.740 1.724 10.415	16.702 977.704 10.617	9.925 18.428 -3.260	.906 18.389 18.408	55.750 18.428 575.987
79.97	7.529 .850 16.761	.895 2.227 10.318	.504 .018 10.900	.740 1.665 10.440	16.761 977.704 10.634	9.961 18.436 -3.227	.910 18.378 18.407	55.773 18.407 575.217
85.00	7.619 .965 16.912	.906 2.112 10.369	.508 .019 10.944	.750 1.514 10.473	16.912 987.749 10.714	9.934 18.443 -3.122	.918 18.402 18.423	55.888 18.423 575.217
89.98	7.708 .822 17.059	.915 2.255 10.384	.515 .019 10.995	.756 1.367 10.510	17.059 996.334 10.713	9.920 18.433 -3.265	.926 18.374 18.404	55.745 18.404 576.252
94.96	7.797 .779 17.102	.916 2.298 10.388	.516 .019 11.010	.757 1.324 10.549	17.102 996.876 10.738	9.939 18.469 -3.308	.928 18.384 18.428	55.702 18.426 575.217
100.00	7.887 .923 17.234	.926 2.154 10.455	.520 .019 11.059	.767 1.192 10.583	17.234 1006.817 10.768	9.899 18.454 -3.154	.935 18.392 18.423	55.846 18.423 575.217

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
.932	56.623	.908

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.513	.778	16.728	9.552	575.987	1.174	1.112

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.508	.776	16.548	9.563	575.987	1.172	.925	56.910

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

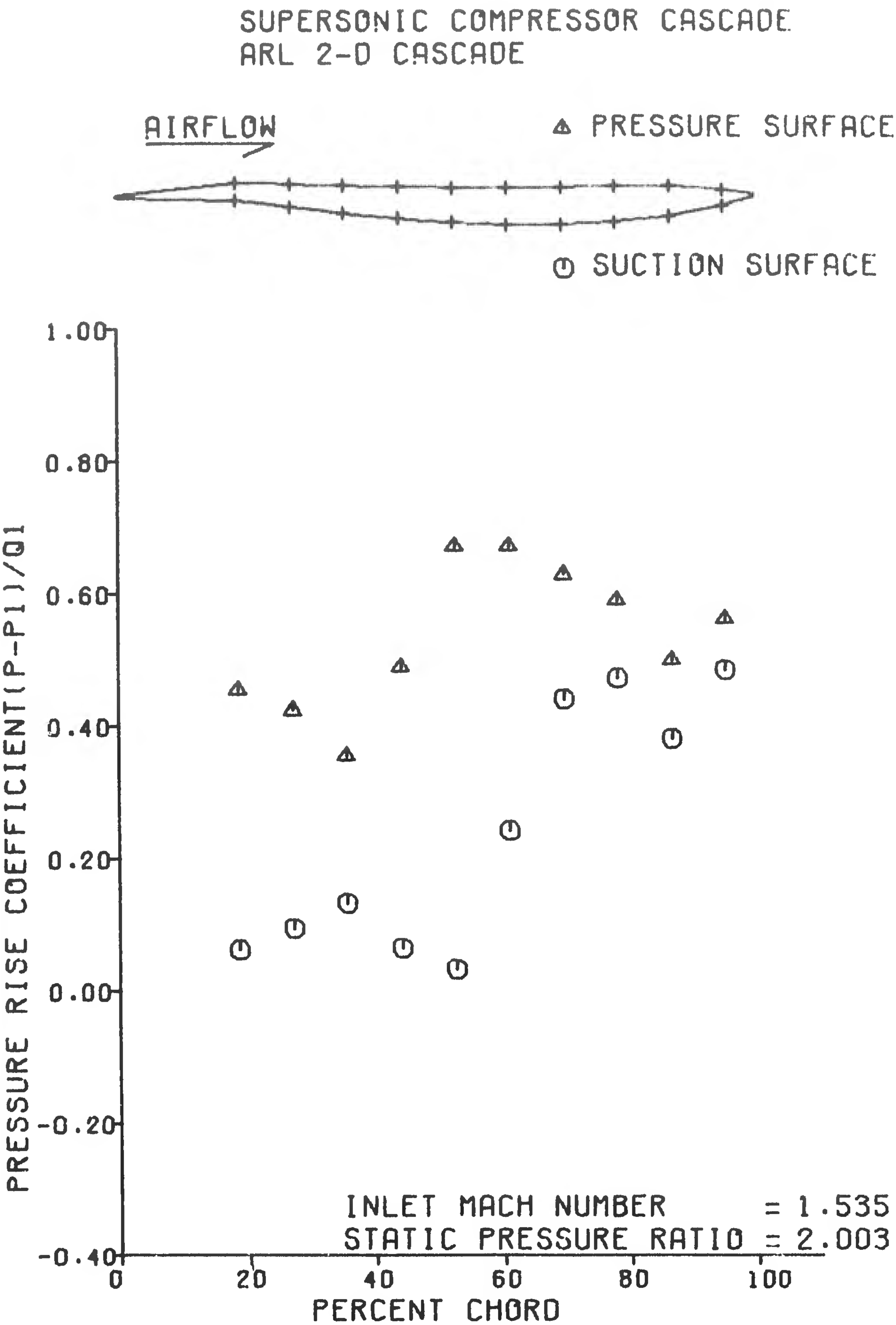
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.003	.908	.680	.706	.669	1.598	1.254	.124
.022	.412	1.735	.281	1.051	.608	1.700	1.377
60.784	.887						

OVERALL PERFORMANCE

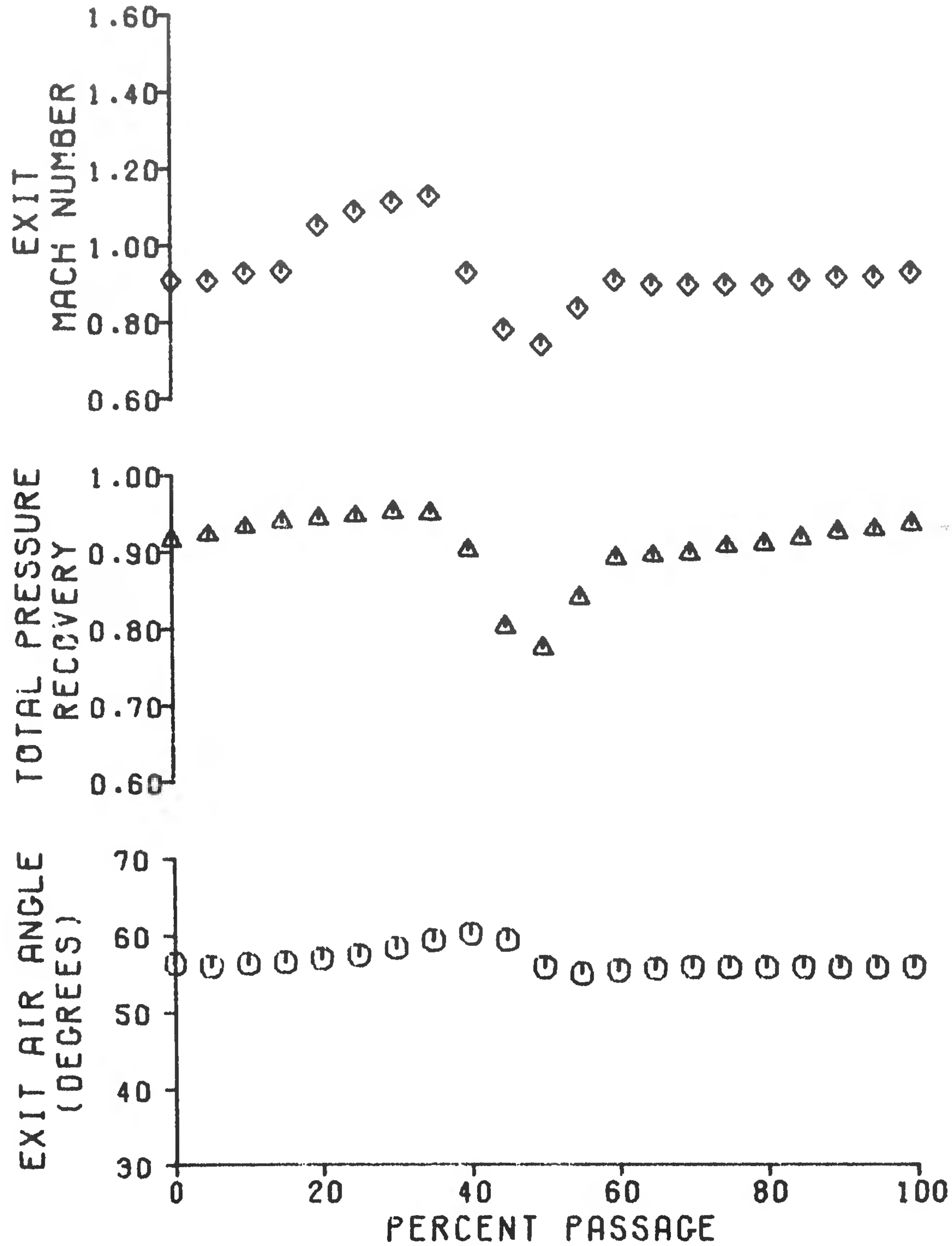
MIXED EXIT CONDITIONS

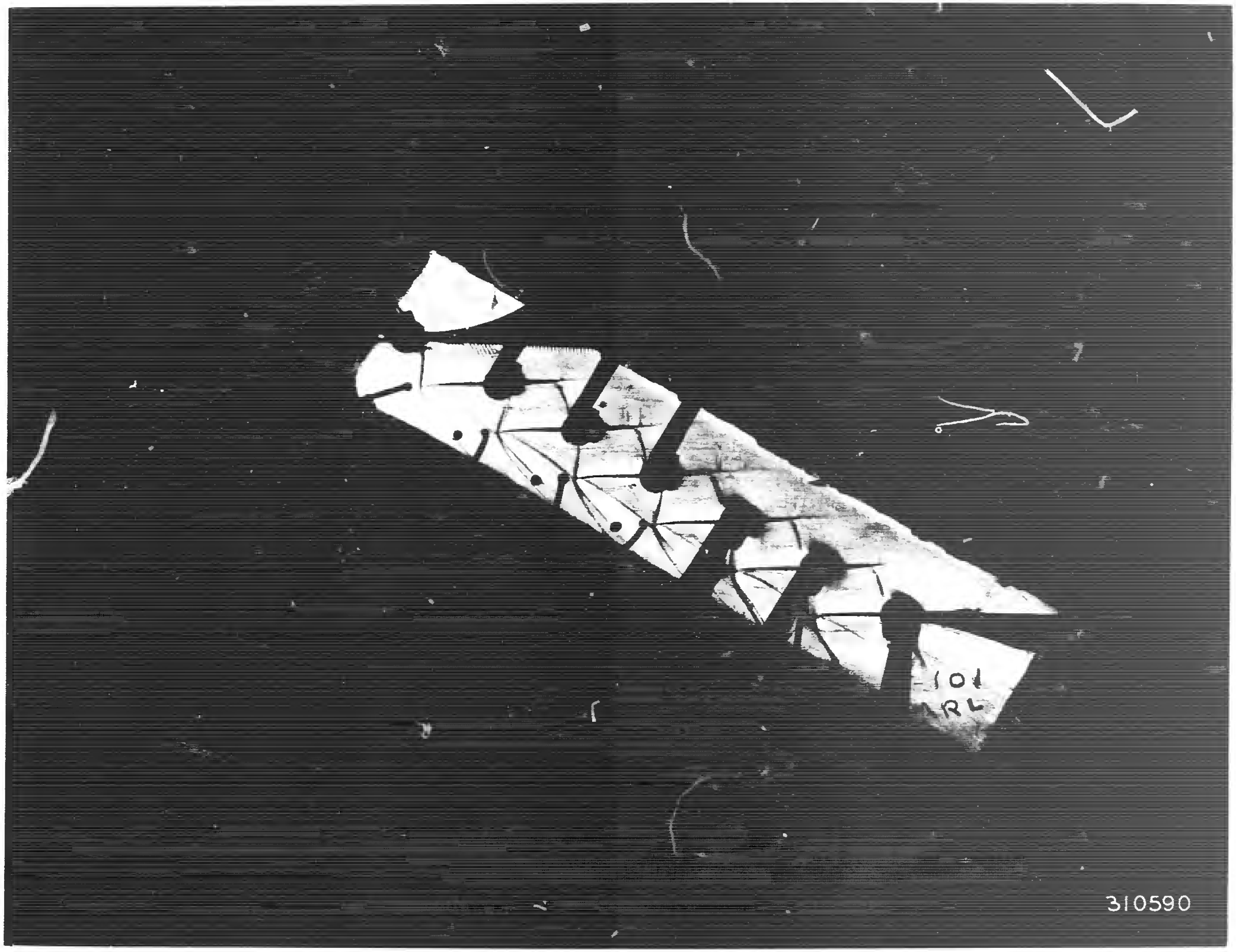
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.005	.904	.676	.697	.668	1.597	1.256	.130
.023	.416	1.744	.281	1.044	.609	1.987	1.090
60.608	.899						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
PRESSURE RISE COEFFICIENT(P-P1)/Q1
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.535
STATIC PRESSURE RATIO = 2.003

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.535
CASCADE STATIC PRESSURE RATIO = 2.003





CASCADE SCHLIEREN

MN)1 = 1.535, P)2/P)1 = 2.003

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.535	2.059	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.460	18.450	18.425	18.422
11	16.836	4.675	8.664	5.348
13	10.486	4.802	7.839	5.715
15	10.939	4.702	7.355	5.975
17	10.530	4.666	8.010	5.256
19	10.664	4.811	10.173	5.332
21	18.393	18.433	10.169	7.991
23	9.725	4.974	9.793	8.836
25	9.762	4.969	9.491	8.476
27	9.831	6.237	8.875	7.399
29	9.883	5.655	9.262	8.378
31	9.881	6.258	18.438	18.440
33	9.727	5.746	9.789	3.535
35	9.725	7.012	9.788	8.298
37	9.860	7.253	10.004	10.126
39	9.721	5.031	10.198	4.713
41	9.720	5.022	4.283	4.618
43	4.723	1.658	3.744	5.264
45	18.414	1.669	3.578	1.651
47	18.440	18.426	18.447	18.433

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.886	1.501	30.990	31.200	576.597

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MNJO	PTJO	TTJO	MJO	BETAJO
1.508	18.431	576.597	8.229	58.800

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	4.974	1.506
WEDGE	25	4.969	1.507
BLADE	27	6.237	1.347
BLADE	29	5.655	1.417
BLADE	31	6.258	1.345
BLADE	33	5.746	1.406
BLADE	35	7.012	1.261
BLADE	37	7.253	1.236

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.508	-.800	40.649	1.535	1.000	.981

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
56.934	2.733	1.787	.025	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
50.947	53.797	52.232	54.923

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.535	18.431	576.597	58.000	4.771	.322	7.870

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	RE/10**6
4.203	5.968	.813	1.302	1.471	3.863	1.145

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.725	33	9.727
25	9.762	35	9.725
27	9.831	37	9.868
29	9.883	39	9.72[illegible]
31	9.881	41	9.720

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
9.816	.063	9.751	.055	.993	2.058

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	5.831	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.022	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.713	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.618	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	5.264	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	563.148	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.651	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.123	PSIA
SECONDARY BLEED FLOW RATE	=	.447	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.054	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.664	5.348	.495	.073	.470	.290	18.65	18.64
13	7.839	5.715	.398	.120	.425	.310	27.14	27.15
15	7.355	5.975	.328	.153	.399	.324	35.64	35.64
17	8.010	5.256	.412	.062	.435	.285	44.09	44.12
19	10.173	5.332	.686	.071	.552	.289	52.62	52.62
21	10.169	7.991	.686	.409	.552	.434	61.11	61.12
23	9.793	8.836	.638	.517	.531	.479	69.57	69.61
25	9.491	8.476	.600	.471	.515	.460	78.08	78.13
27	8.875	7.399	.522	.334	.482	.401	86.57	86.60
29	9.262	8.378	.571	.458	.503	.455	95.74	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.245	-.208	.129	-31.803	-.085	.245	.112	45.126

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,4 TT)1
.00	6.100 1.447 16.793	.885 1.530 10.438	.490 .000 10.910	.737 1.638 10.536	16.793 968.189 10.734	10.895 18.453 -2.843	.911 18.395 18.424	56.370 18.424 576.597
4.98	6.180 1.250 16.862	.895 1.827 10.421	.498 .014 10.933	.744 1.569 10.535	16.862 978.153 10.740	10.022 18.430 -2.827	.915 18.395 18.413	56.173 18.413 576.252
9.96	6.278 1.380 17.067	.908 1.497 10.457	.503 .018 10.959	.754 1.364 10.580	17.067 988.340 10.771	10.226 18.451 -2.707	.925 18.403 18.427	56.303 18.427 575.907
15.00	6.368 1.681 17.202	.928 1.396 10.479	.511 .019 10.939	.774 1.229 10.575	17.202 1008.445 10.779	9.868 18.459 -2.406	.933 18.405 18.432	56.604 18.432 575.907
19.98	6.457 1.956 17.259	.927 1.121 10.493	.507 .019 10.903	.777 1.172 10.586	17.259 1008.218 10.788	9.903 18.451 -2.121	.936 18.413 18.432	56.879 18.432 576.941
24.96	6.546 2.554 17.313	1.053 .523 10.487	.566 .018 10.814	.888 1.115 10.550	17.318 1121.298 10.751	8.500 18.431 -1.523	.939 18.393 18.412	57.477 18.412 575.217
5	6.637 3.355 17.354	1.087 -.278 10.497	.572 .019 10.653	.925 1.864 10.523	17.367 1150.902 10.693	8.263 18.455 -.712	.942 18.397 18.426	58.278 18.426 575.907

156

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA) PT)0, TT)1
35.03	6.726 4.311 17.345	1.110 -1.234 10.466	.568 .018 10.413	.954 1.262 10.432	17.369 1170.587 10.601	8.038 18.461 .234	.942 18.398 18.428	59.234 18.428 576.252
40.01	6.815 5.208 16.423	.908 -2.131 10.425	.451 .017 10.222	.788 2.008 10.287	16.423 988.342 10.388	9.647 18.453 1.131	.891 18.425 18.439	60.131 18.439 575.217
44.99	6.904 4.308 14.705	.788 -1.319 10.257	.392 .015 10.216	.660 3.725 10.087	14.726 854.883 10.146	9.954 18.432 .309	.798 18.389 18.418	59.319 18.418 576.252
49.97	6.993 1.014 14.136	.722 2.983 10.937	.404 .014 10.397	.598 4.295 9.988	14.136 808.737 10.080	9.990 18.413 -3.853	.767 18.408 18.418	55.937 18.418 576.597
55.01	7.083 -.807 15.212	.807 3.174 9.971	.465 .016 10.582	.659 3.219 10.075	15.212 863.198 10.229	9.913 18.430 -4.184	.825 18.409 18.420	54.826 18.420 575.217
59.99	7.172 .763 16.359	.895 2.314 10.947	.505 .017 10.631	.739 2.072 10.213	16.359 978.289 10.401	9.722 18.466 -3.324	.888 18.403 18.435	55.686 18.435 574.872
64.97	7.261 1.104 16.401	.885 1.973 10.155	.494 .018 10.675	.734 2.030 10.305	16.491 968.189 10.480	9.860 18.452 -2.983	.898 18.385 18.419	56.827 18.419 576.252

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A TT)1
70.01	7.351 1.438 16.448	.885 1.641 10.257	.490 .018 10.720	.736 1.983 10.358	16.448 968.189 10.536	9.888 10.417 -2.651	.892 10.391 10.404	56.358 10.404 576.252
74.99	7.440 1.386 16.443	.877 1.771 10.298	.487 .018 10.777	.729 1.988 10.409	16.443 960.639 10.583	9.969 10.434 -2.771	.892 10.422 10.428	56.229 10.428 575.987
79.97	7.529 1.174 16.495	.876 1.903 10.333	.489 .018 10.836	.727 1.936 10.461	16.495 959.818 10.593	10.013 10.456 -2.903	.895 10.385 10.428	56.097 10.428 575.882
85.00	7.619 1.189 16.568	.888 1.888 10.349	.490 .018 10.854	.730 1.863 10.474	16.568 963.558 10.628	10.012 10.454 -2.885	.899 10.412 10.433	56.112 10.433 576.597
89.98	7.708 1.079 16.635	.884 1.998 10.355	.494 .018 10.885	.733 1.796 10.488	16.635 967.771 10.631	10.005 10.438 -2.998	.903 10.385 10.412	56.002 10.412 576.597
94.96	7.797 1.033 16.688	.884 2.044 10.382	.495 .018 10.924	.733 1.743 10.508	16.688 968.078 10.669	10.033 10.433 -3.054	.905 10.387 10.410	55.956 10.410 575.562
100.00	7.887 1.055 16.760	.885 2.022 10.399	.495 .018 10.937	.733 1.671 10.535	16.760 968.189 10.678	10.075 10.438 -3.022	.909 10.403 10.421	55.978 10.421 575.987

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
.907	56.752	.897

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.497	.758	16.539	9.710	576.597	1.164	1.093

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.491	.756	16.466	9.716	576.598	1.163	.902	57.013

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

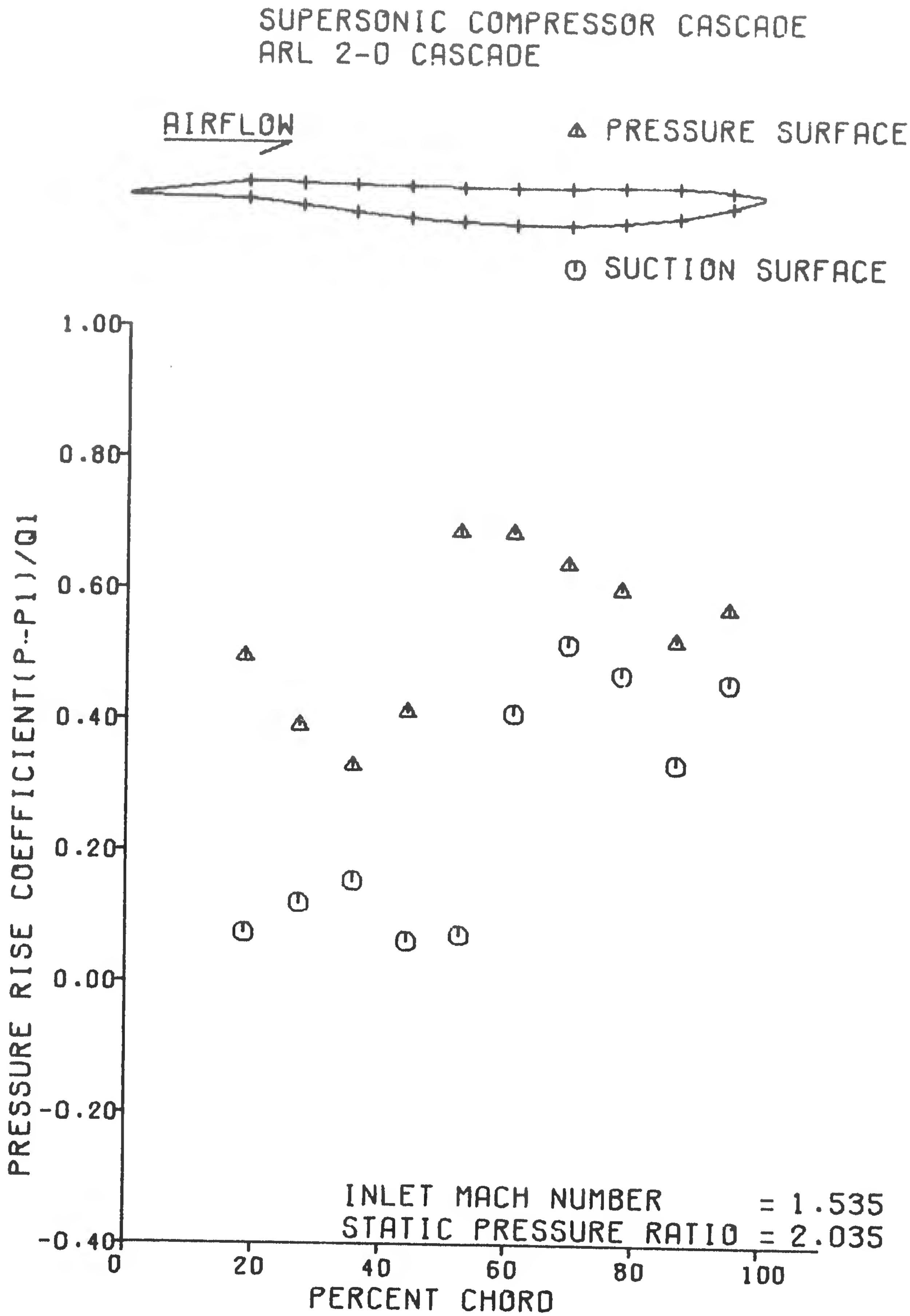
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.035	.897	.664	.687	.655	1.611	1.264	.139
.025	.432	1.780	.293	1.027	.628	1.829	1.248
60.288	.904						

OVERALL PERFORMANCE

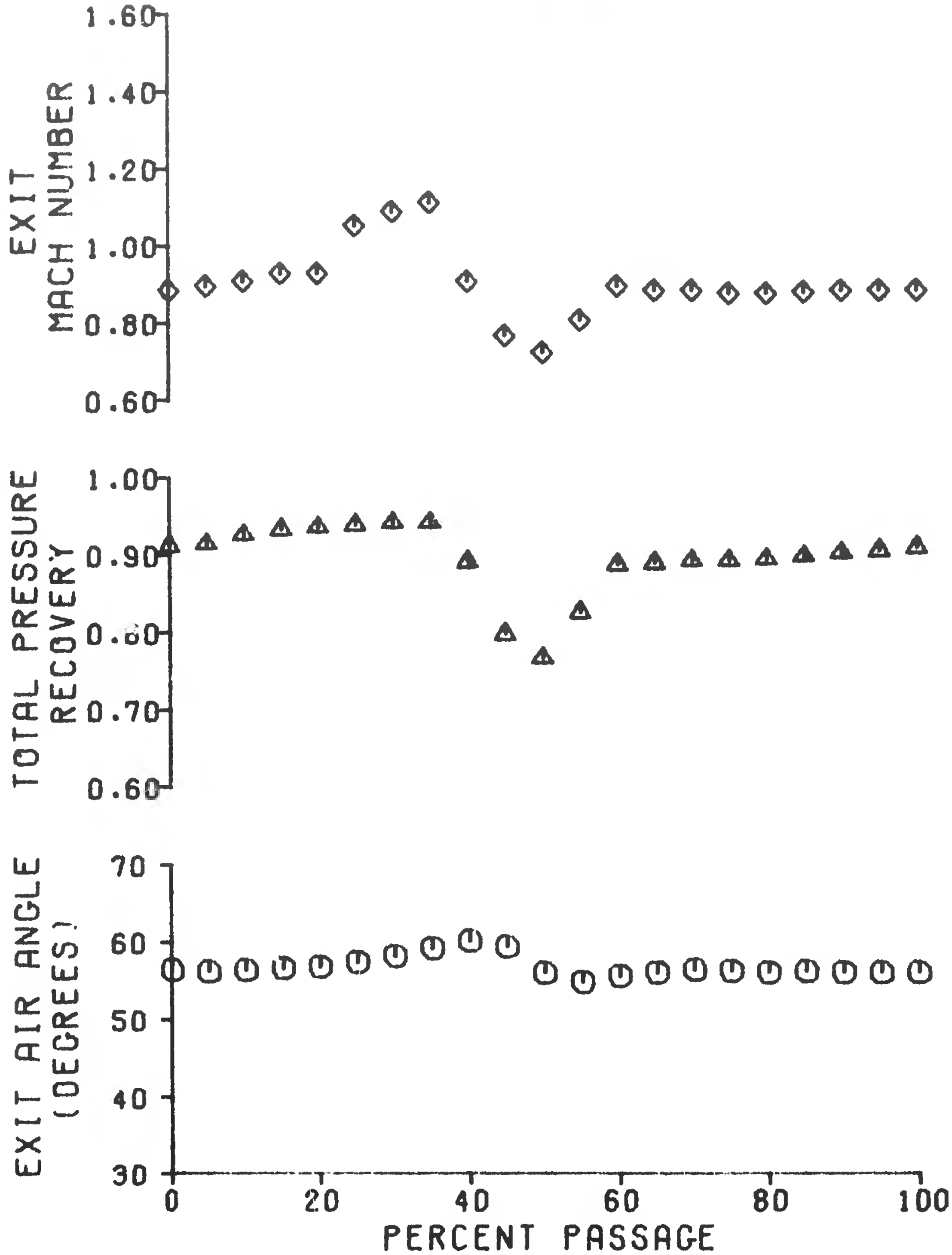
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.036	.893	.661	.679	.654	1.609	1.265	.144
.026	.435	1.789	.294	1.021	.628	2.090	.987
60.116	.915						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
PRESSURE RISE COEFFICIENT(P-P1)/Q1
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.535
STATIC PRESSURE RATIO = 2.035

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.535
CASCADE STATIC PRESSURE RATIO = 2.035



CASCADE SCHLIEREN

$MN11 = 1.535$, $P12/P11 = 2.035$

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.535	2.270	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	10.552	10.548	10.548	10.537
11	16.713	4.697	8.530	5.401
13	12.437	4.650	7.629	6.036
15	13.979	8.863	7.582	5.952
17	13.539	4.601	8.021	5.178
19	12.753	4.878	12.422	7.371
21	10.491	10.521	10.253	8.972
23	9.887	4.962	9.945	9.178
25	9.923	4.991	9.685	8.305
27	9.986	6.638	9.186	7.132
29	13.032	6.662	9.574	8.808
31	12.015	7.071	10.527	10.537
33	9.817	6.640	9.821	4.157
35	9.883	7.149	9.918	8.916
37	9.980	7.246	10.078	10.245
39	9.913	5.051	10.265	4.948
41	9.776	5.045	4.332	5.038
43	5.296	1.638	3.804	5.665
45	10.538	1.645	3.611	1.624
47	10.515	10.517	10.525	10.542

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.895	1.501	31.000	31.200	574.872

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MA1D	PT1D	TT1D	M1D	BETA1D
1.508	10.519	574.872	8.281	58.000

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	4.992	1.507
WEDGE	25	4.991	1.507
BLADE	27	6.638	1.305
BLADE	29	6.662	1.302
BLADE	31	7.071	1.259
BLADE	33	6.640	1.305
BLADE	35	7.149	1.250
BLADE	37	7.246	1.240

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.508	-.810	40.638	1.535	1.000	.981

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STARGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
56.934	2.733	1.787	.775	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
56.537	61.747	62.855	54.[illegible]

CASCADE INLET CONDITIONS

MN11	PT11	TT11	[illegible]	[illegible]	[illegible]	[illegible]
1.-15	18.510	576.833	58.204	4.771	.524	7.547

[illegible]	[illegible]	MN1I.	[illegible]	[illegible]	[illegible]	[illegible]
4.213	4.088	.914	1.292	1.472	3.865	1.158

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
2[illegible]	9.887	33	9.817
25	9.927	35	9.883
27	9.986	37	9.980
29	10.232	39	9.813
31	10.215	41	9.776

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
9.958	.355	9.[illegible]	.175	.904	2.881

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	5.951	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.945	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.948	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	5.038	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	5.865	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	559.355	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.624	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.118	PSIA
SECONDARY BLEED FLOW RATE	=	.437	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.053	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

[illegible] BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	PS/P1 (PS)	SS/P1 (SS)	PS/PT1	SS/PT1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	9.532	[illegible]	[illegible]	.277	[illegible]	.292	18.48	18.84
13	7.629	[illegible]	[illegible]	[illegible]	.312	.326	27.14	27.15
15	7.582	5.982	[illegible]	.147	[illegible]	.321	35.64	35.64
17	8.321	5.176	[illegible]	.249	[illegible]	.282	44.29	44.12
19	10.422	7.371	.712	[illegible]	[illegible]	.398	52.62	52.62
21	10.252	8.472	[illegible]	.529	[illegible]	.484	61.11	61.17
23	9.945	9.176	.552	[illegible]	.537	.496	69.57	69.61
25	9.665	8.495	.619	.424	.523	.448	78.38	78.13
27	9.166	7.142	.556	.294	.466	.385	86.37	86.62
29	9.574	[illegible]	.595	[illegible]	.517	.478	95.84	95.96

FC	FMAX	FMIN	ALPHA	CMAX	CLIT	PCILE	CPILE
.217	-.184	.114	-31.840	[illegible]	.217	.499	45.891

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y / DEV / PT)YP	MN)2 / TURN / P)TP	MN)X,2 / M)2 / P)BP	MN)Y,2 / DP)1,2 / P)NP	PT)2 / V)2 / P)SP	P)2 / PT)0 / BETA)P	PT)2/PT)1 / PT)0 / PT)1	BETA)2 / PT)0,A / TT)1
	6.100	.875	.487	.726	15.717	10.154	.903	56.137
.02	1.214	1.863	.002	1.803	957.538	18.544	18.524	18.534
	15.717	10.473	10.978	10.596	10.767	-2.873	18.534	573.838
	6.189	.877	.492	.727	16.747	10.145	.904	55.906
4.98	.983	2.094	.018	1.772	959.952	18.552	18.470	18.511
	16.747	10.467	11.012	10.589	10.755	-3.394	18.511	573.493
	6.278	.891	.499	.730	16.960	10.120	.916	55.935
9.96	1.012	2.265	.018	1.560	973.225	18.528	18.486	18.507
	16.960	10.494	11.052	10.625	10.797	-3.075	18.507	574.183
	6.368	.906	.504	.753	17.116	10.054	.924	56.209
15.02	1.286	1.791	.019	1.423	985.861	18.568	18.502	18.535
	17.116	10.514	11.035	10.642	10.815	-2.801	18.535	574.183
	6.457	.915	.505	.763	17.205	10.005	.929	56.535
19.98	1.612	1.455	.019	1.315	995.439	18.546	18.510	18.528
	17.205	10.533	11.001	10.641	10.818	-2.475	18.528	574.183
	6.546	.925	.505	.776	17.271	9.932	.933	56.947
24.96	2.224	1.053	.019	1.246	1004.912	18.554	18.498	18.525
	17.271	10.534	10.926	10.631	10.787	-2.053	18.525	574.528
	6.637	1.053	.559	.803	17.337	8.602	.936	57.982
30.05	3.030	.738	.019	1.182	1119.620	18.542	18.480	18.515
	17.334	10.537	10.760	10.587	10.737	-1.039	18.515	574.528
	6.726	1.053	.542	.903	17.178	8.522	.928	59.024
35.03	4.101	-1.024	.018	1.341	1119.620	18.569	18.508	18.538
	17.175	10.527	10.524	10.519	10.628	.014	18.538	574.183
	6.815	.840	.427	.723	15.834	9.980	.855	59.405
40.01	4.482	-1.405	.016	2.685	923.769	18.545	18.499	18.522
	15.834	10.444	10.381	10.365	10.398	.395	18.522	574.528
	6.904	.721	.387	.609	14.341	10.141	.774	57.568
44.99	2.645	.432	.015	4.178	806.858	18.555	18.479	18.517
	14.341	10.271	10.444	10.166	10.215	-1.442	18.517	573.838
	6.993	.721	.419	.587	14.355	10.154	.775	54.490
49.97	-.433	3.510	.015	4.164	806.514	18.529	18.492	18.511
	14.355	10.108	10.549	10.143	10.242	-4.522	18.511	574.872
	7.083	.822	.477	.667	15.610	10.033	.843	54.447
55.01	-.476	3.553	.016	2.909	905.193	18.548	18.513	18.532
	15.610	10.290	10.765	10.249	10.425	-4.553	18.530	573.838
	7.172	.880	.502	.724	16.414	9.919	.886	55.366
59.99	.443	2.634	.018	2.106	962.052	18.559	18.511	18.535
	16.414	10.168	10.799	10.354	10.581	-3.644	18.535	574.528
	7.261	.863	.485	.714	16.328	10.241	.882	55.822
64.97	.897	2.150	.015	2.191	945.421	16.529	18.505	18.519
	16.328	10.275	10.814	10.404	10.637	-3.192	18.519	574.183

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y / DEV / PT)YP	MN)2 / TURN / P)TP	MN)X,2 / M)2 / P)BP	MN)Y,2 / DP)1,2 / P)AP	PT)2 / V)2 / P)SP	P)2 / PT)0 / BETA)P	PT)2/PT)1 / PT)0 / PT)1	BETA)2 / PT)0,A / TT)1
	7.351	.858	.483	.710	16.302	10.285	.880	55.932
70.21	1.029	2.368	.018	2.217	941.011	18.534	18.499	18.516
	16.332	10.329	10.843	10.445	10.681	-3.368	18.518	573.148
	7.440	.859	.482	.713	16.373	10.108	.884	56.034
74.99	1.111	1.965	.018	2.146	942.855	18.555	18.500	18.528
	16.373	10.375	10.877	10.485	10.691	-2.976	18.528	574.183
	7.520	.860	.481	.714	16.417	10.125	.886	56.052
79.97	1.129	1.948	.019	2.102	943.811	18.564	18.518	18.541
	16.417	10.402	10.903	10.495	10.714	-2.958	18.541	574.183
	7.610	.863	.484	.715	16.471	10.120	.889	55.928
[illegible]	1.075	2.072	.018	2.048	945.421	18.538	18.465	18.502
	16.471	10.487	10.931	10.524	10.708	-3.072	18.502	573.403
	7.738	.863	.484	.715	15.497	10.145	.891	55.919
89.98	.906	2.381	.016	2.022	946.421	18.521	18.502	18.511
	16.497	10.411	10.939	10.528	10.716	-3.091	18.511	573.493
	7.797	.870	.489	.720	16.626	10.149	.898	55.848
94.96	.925	2.152	.018	1.893	953.105	18.553	18.501	18.527
	16.626	10.431	10.982	10.552	10.739	-3.162	18.527	573.493
	7.887	.877	.493	.726	16.714	10.126	.902	55.827
100.00	.974	2.173	.018	1.806	959.845	18.541	18.523	18.532
	16.714	10.436	10.995	10.551	10.756	-3.173	18.532	574.872

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
.879	56.344	.889

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.487	.732	16.454	9.940	574.872	1.155	1.000

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.483	.731	16.391	9.946	574.872	1.153	.876	56.558

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

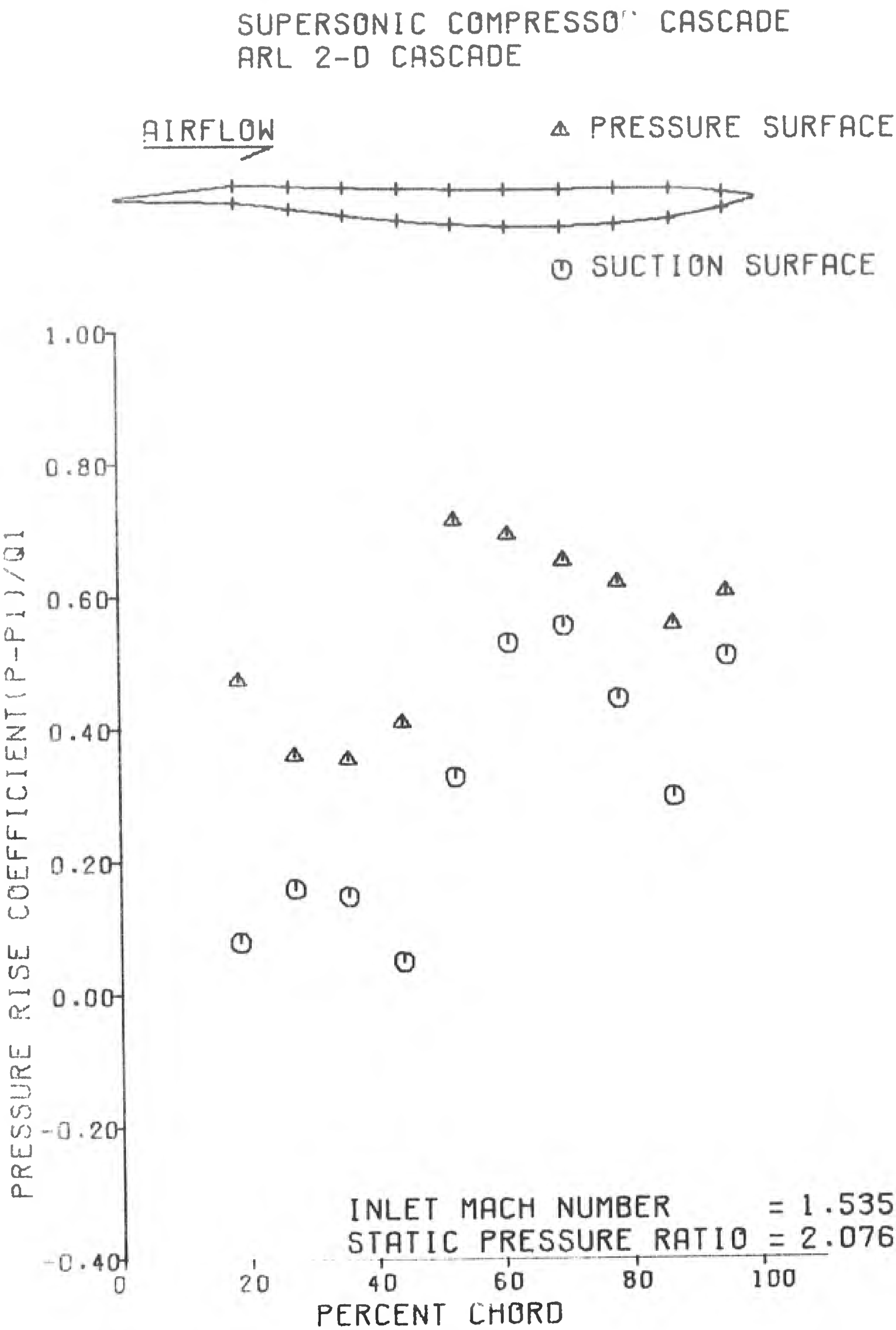
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.076	.889	.646	.676	.635	1.629	1.274	.150
.027	.455	1.834	.310	1.014	.652	1.421	1.556
59.792	.908						

OVERALL PERFORMANCE

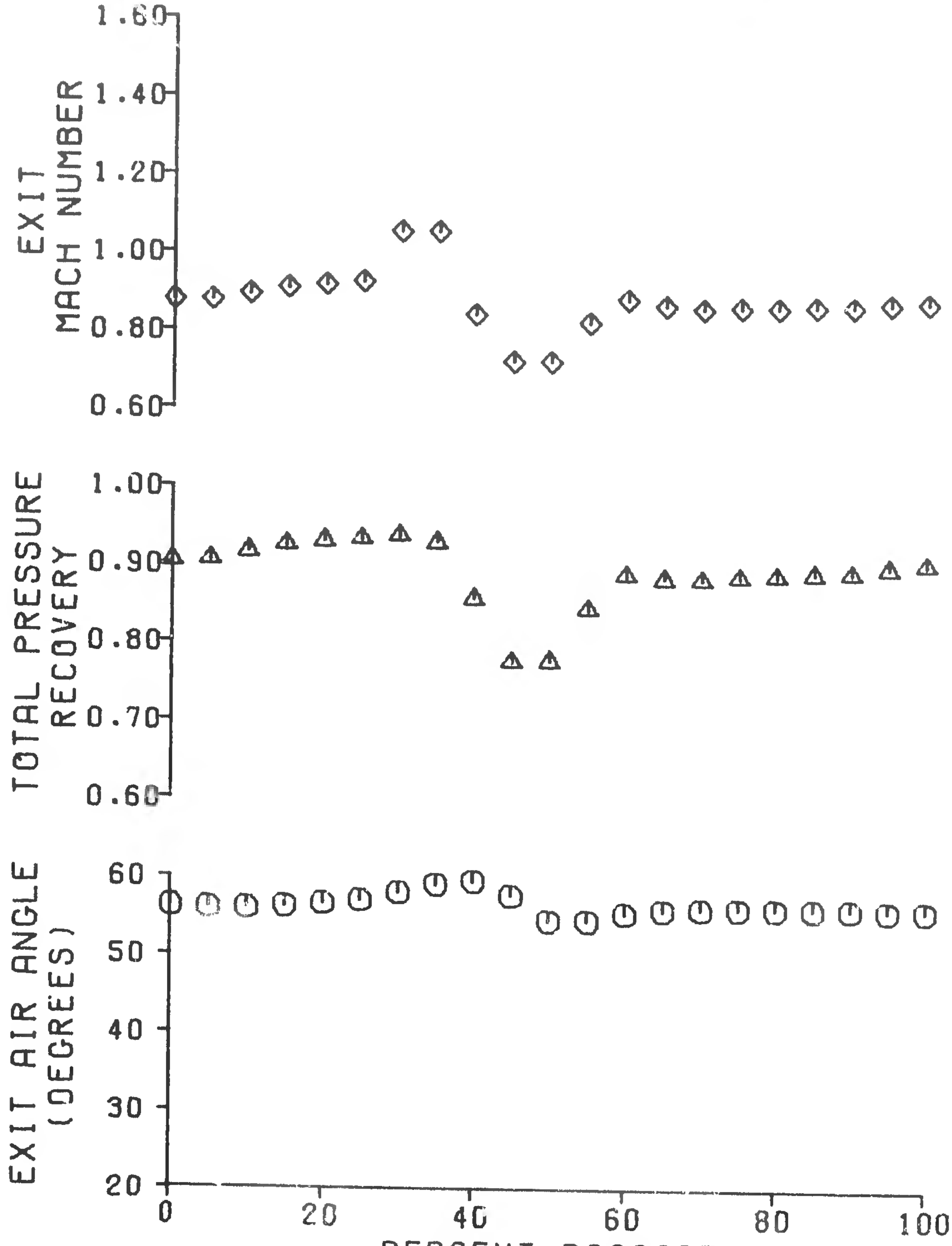
MIXED EXIT CONDITIONS

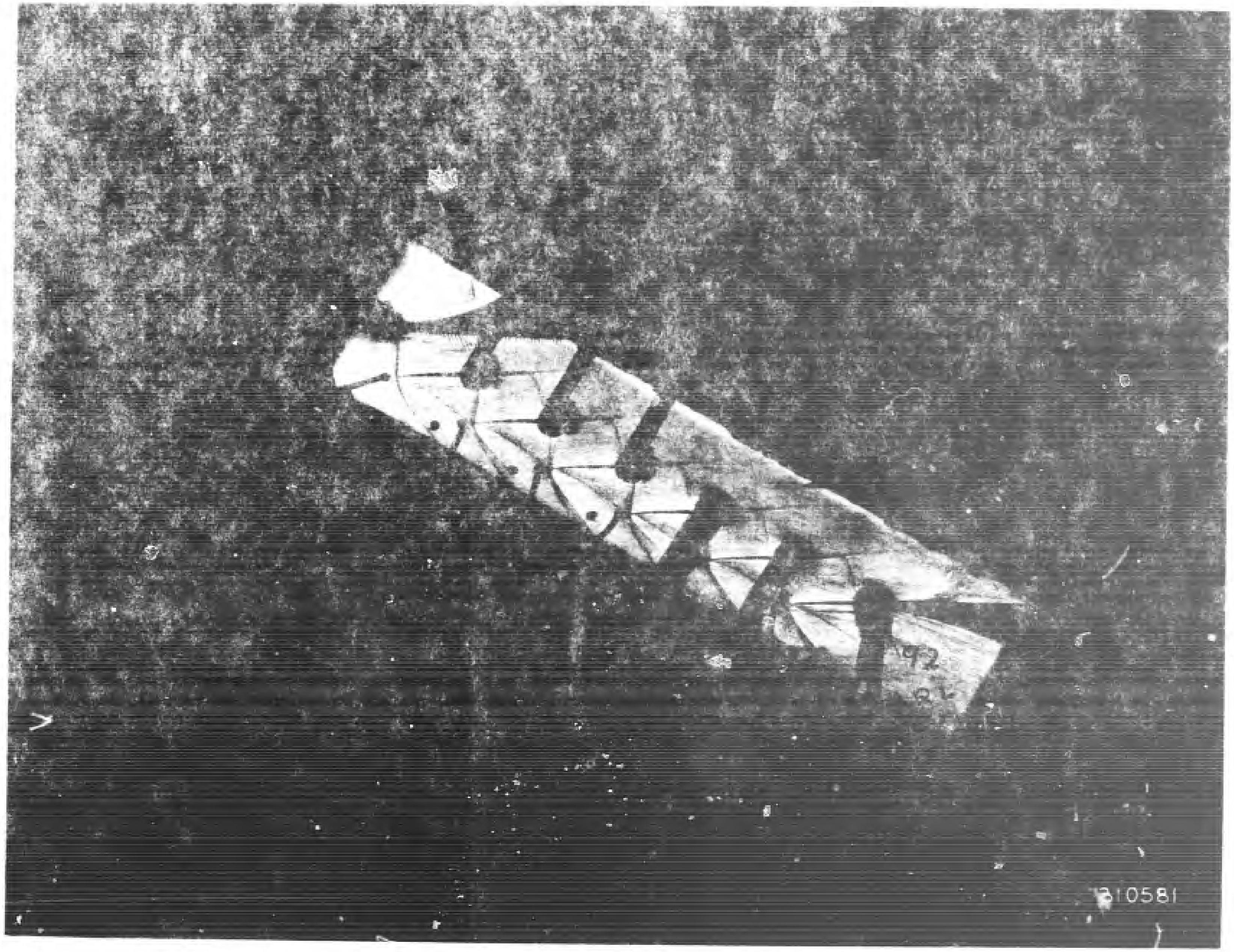
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.076	.885	.644	.670	.634	1.627	1.276	.155
.028	.457	1.840	.310	1.009	.652	1.627	1.450
59.636	.917						


SUPERSONIC COMPRESSO" CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
PRESSURE RISE COEFFICIENT(P-P1)/Q1
INLET MACH NUMBER = 1.535
STATIC PRESSURE RATIO = 2.076
0
20
40
60
80
100
PERCENT CHORD

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.535
CASCADE STATIC PRESSURE RATIO = 2.076





CASCADE SCHLIEREN
MN)1 = 1.535, P)2/P)1 = 2.076

APPENDIX E

CASCADE PERFORMANCE DATA

MN)1 = 1.616

P)2/P)1 = 1.220

P)2/P)1 = 1.468

P)2/P)1 = 1.672

P)2/P)1 = 1.870

P)2/P)1 = 2.036

P)2/P)1 = 2.097

P)2/P)1 = 2.220

P)2/P)1 = 2.300

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.616	1.282	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.724	18.724	18.706	18.738
11	17.758	4.767	5.499	4.843
13	7.540	4.842	4.939	4.940
15	7.849	4.633	4.542	4.866
17	7.584	4.776	4.573	4.678
19	7.903	4.843	4.169	4.487
21	18.668	18.705	3.977	4.476
23	5.338	5.098	3.972	4.187
25	5.486	5.116	4.099	4.218
27	5.670	4.321	5.373	5.542
29	5.556	4.343	6.000	5.301
31	5.426	4.460	18.704	18.719
33	5.489	4.154	5.275	1.937
35	5.316	4.275	5.556	4.579
37	5.390	4.500	5.705	5.879
39	5.313	5.041	6.231	4.780
41	6.145	5.040	4.481	4.765
43	4.632	1.437	4.026	4.628
45	18.674	1.444	2.841	1.424
47	18.712	18.702	18.709	18.708

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.893	1.501	31.000	29.310	573.838

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

PM1D	PT1D	TT1D	M1D	BETA1D
1.500	18.701	573.838	8.370	62.600

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.098	1.499
WEDGE	25	5.116	1.497
BLADE	27	4.321	1.612
BLADE	29	4.343	1.600
BLADE	31	4.460	1.591
BLADE	33	4.154	1.639
BLADE	35	4.275	1.619
BLADE	37	4.500	1.585

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	-3.430	38.228	1.516	1.000	.843

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
56.934	2.733	1.787	.025	1.000	1.000

INLET METAL ANGLE PS	SS (DEGREES)	ML	EXIT METAL ANGLE ML (DEG.)
50.947	53.797	52.032	54.923

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.616	18.701	573.838	57.250	4.296	.318	7.854

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
3.453	5.218	.874	1.359	1.522	4.353	1.140

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	5.338	33	5.489
25	5.486	35	5.318
27	5.670	37	5.390
29	5.556	39	5.313
31	5.426	41	6.145

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
5.495	.113	5.531	.314	1.447	1.279

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	5.041	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.046	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.788	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.765	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.628	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	559.700	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.424	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.085	PSIA
SECONDARY BLEED FLOW RATE	=	.358	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.042	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	5.499	4.843	.153	.078	.294	.259	18.65	18.84
13	4.939	4.940	.082	.082	.264	.264	27.14	27.15
15	4.542	4.868	.031	.073	.243	.260	35.64	35.64
17	4.573	4.678	.035	.049	.245	.250	44.89	44.12
19	4.169	4.487	-.016	.024	.223	.240	52.62	52.62
21	3.977	4.476	-.041	.023	.213	.239	61.11	61.10
23	3.972	4.187	-.041	-.014	.212	.224	69.57	69.61
25	4.099	4.216	-.025	-.010	.219	.225	78.08	78.13
27	5.373	5.542	.137	.159	.287	.296	86.57	86.60
29	6.000	5.301	.319	.128	.364	.283	95.04	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	M)LE	CP)LE
.005	-.005	.002	-22.478	-.001	.065	.002	44.776

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
	6.100	1.440	.794	1.202	18.502	5.490	.989	58.562
.00	1.639	.688	.000	.199	1421.915	18.727	18.664	18.695
	17.531	7.127	7.758	7.131	7.816	-2.448	18.695	574.183
DELP PROBE	-.345							
	6.189	1.491	.807	1.253	18.701	5.163	1.000	57.209
4.98	2.286	.041	.017	.000	1456.432	18.721	18.667	18.694
	17.764	6.965	7.438	6.961	7.537	-1.791	18.694	573.493
DELP PROBE	-.107							
	6.278	1.533	.824	1.293	18.701	4.854	1.000	57.504
9.96	2.581	-.254	.017	.000	1484.838	18.722	18.661	18.690
	17.641	6.716	7.115	6.667	7.163	-1.505	18.690	572.803
DELP PROBE	-.399							
	6.368	1.555	.815	1.324	18.701	4.699	1.000	58.379
15.00	3.456	-1.129	.016	.000	1499.268	18.726	18.661	18.694
	17.407	6.541	6.807	6.428	6.910	-.631	18.694	572.803
DELP PROBE	-.276							
	6.457	1.554	.799	1.345	18.701	4.638	1.000	59.268
19.98	4.345	-2.018	.016	.000	1508.073	18.708	18.667	18.687
	17.235	6.660	6.590	6.306	6.766	.268	18.687	572.803
DELP PROBE	-.117							
	6.546	1.569	.782	1.360	18.701	4.605	1.000	60.097
24.96	5.174	-2.847	.015	.000	1508.224	18.714	18.666	18.690
	17.057	6.664	6.382	6.214	6.681	1.087	18.690	572.803

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
	6.637	1.567	.779	1.359	18.612	4.602	.995	60.202
30.05	5.279	-2.952	.015	.089	1506.569	18.598	18.655	18.676
	16.888	6.589	6.283	6.207	6.659	1.192	18.676	573.148
	6.726	1.575	.785	1.366	18.529	4.522	.991	60.123
35.03	5.200	-2.873	.015	.172	1512.079	18.709	18.660	18.685
	16.756	6.455	6.171	6.136	6.594	1.113	18.685	573.148
	6.815	1.586	.786	1.378	18.504	4.442	.989	60.289
40.01	5.366	-3.039	.015	.197	1519.285	18.716	18.653	18.684
	16.658	6.368	5.940	6.051	6.512	1.289	18.684	572.459
	6.904	1.585	.765	1.387	18.317	4.409	.979	61.118
44.99	6.195	-3.868	.014	.384	1518.041	18.735	18.674	18.705
	16.502	6.437	5.905	6.002	6.427	2.108	18.705	573.493
	6.993	1.316	.726	1.098	14.984	5.293	.801	56.535
49.97	1.612	.715	.015	3.716	1331.518	18.715	18.676	18.695
	14.633	6.909	7.417	7.093	6.749	-2.475	18.695	573.148
	7.083	1.117	.494	1.002	12.954	5.941	.693	63.753
55.01	8.830	-6.503	.013	5.747	1173.221	18.718	18.660	18.689
	12.933	8.279	7.482	7.689	7.646	4.743	18.689	573.838
	7.172	1.304	.625	1.144	15.771	5.665	.843	61.375
59.99	6.452	-4.125	.013	2.929	1322.357	18.725	18.648	18.687
	15.436	7.736	7.223	7.320	7.712	2.365	18.687	573.148

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 CP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
64.07	7.281 3.292 16.983	1.385 -.965 7.521	.729 .015 7.716	1.177 1.048 7.201	17.655 1382.362 8.020	5.568 18.726 -.795	.944 18.642 18.684	58.215 18.684 572.803
70.01	7.351 2.388 17.229	1.404 -.261 7.437	.758 .017 7.863	1.182 .700 7.281	18.201 1394.300 7.752	5.623 18.721 -1.699	.963 18.646 18.684	57.311 18.684 573.493
74.99	7.440 1.108 17.649	1.365 1.129 7.638	.781 .018 8.367	1.133 .439 7.949	18.282 1368.059 8.289	6.027 18.724 -2.889	.977 18.648 18.686	56.121 18.686 573.493
79.97	7.529 2.233 17.916	1.392 .394 7.726	.755 .018 8.207	1.169 .044 7.812	18.657 1387.277 8.172	5.933 18.695 -1.854	.998 18.656 18.676	57.156 18.676 573.493
DELP PROBE -.036								
85.00	7.619 3.682 17.857	1.420 -1.335 7.640	.740 .018 7.751	1.212 .000 7.552	18.701 1407.581 8.041	5.712 18.708 -.425	1.000 18.664 18.686	58.585 18.686 572.803
DELP PROBE -.381								
89.98	7.708 5.434 17.817	1.487 -3.127 7.416	.736 .016 7.058	1.293 .000 7.082	18.701 1454.212 7.520	5.188 18.723 1.347	1.000 18.657 18.690	60.357 18.690 572.803
94.96	7.797 1.234 17.574	1.390 1.093 7.420	.774 .017 8.144	1.154 .408 7.792	18.293 1385.991 7.992	5.832 18.728 -2.853	.978 18.661 18.694	56.157 18.694 572.803

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 CP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
100.00	7.887 2.062 17.770	1.419 -.635 7.544	.754 .018 7.836	1.282 .061 7.574	18.640 1406.856 7.901	5.782 18.721 -1.125	.997 18.644 18.683	57.885 18.683 573.493

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
1.454	58.656	.963

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.756	1.241	18.002	5.243	573.838	1.423	1.003

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.739	1.235	17.799	5.292	573.838	1.414	1.439	59.185

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

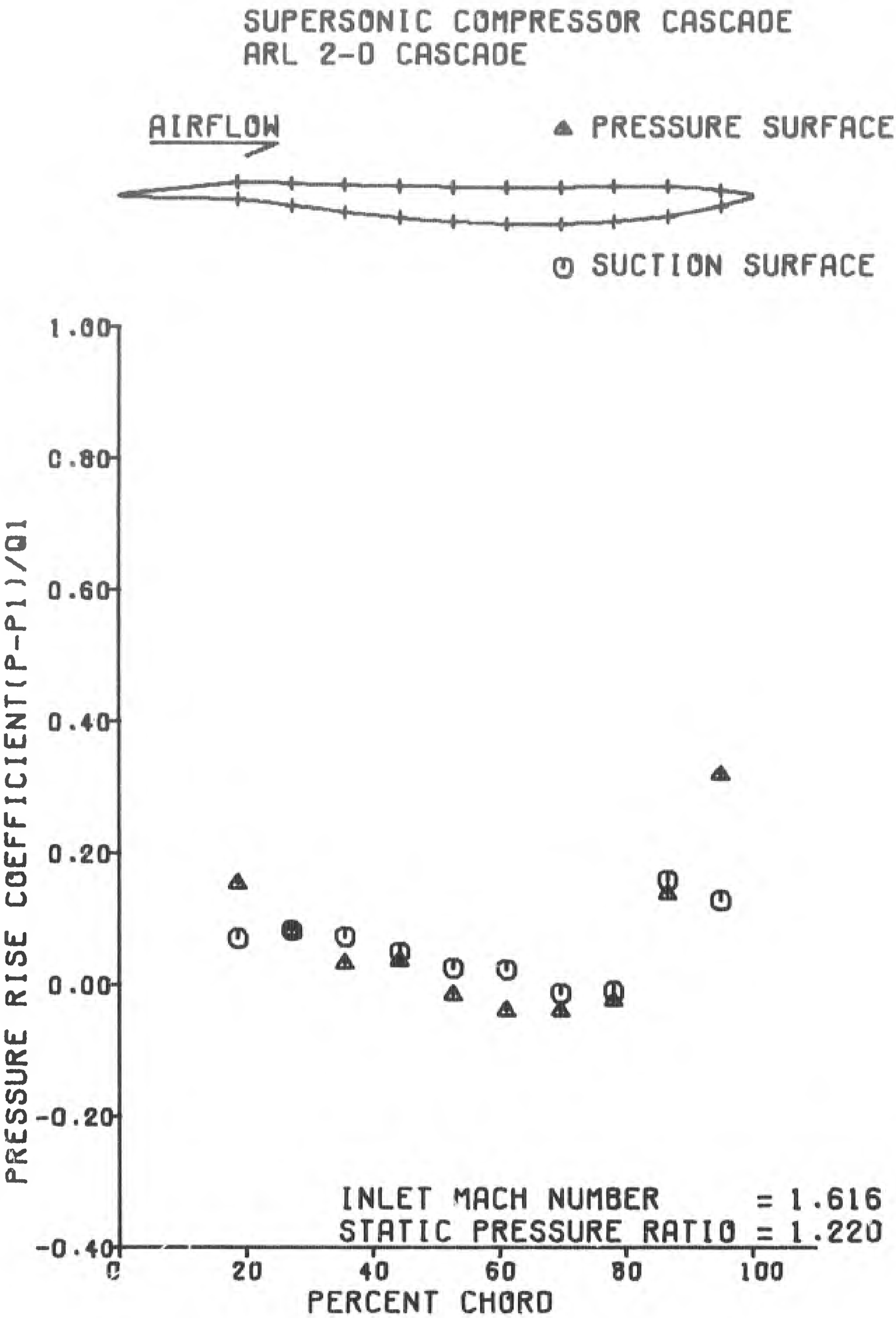
MASS AVERAGED EXIT CONDITIONS

P)2/P)1 TPLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
1.220 .008 59.347	.963 .085 .980	.930 1.215	.895 .046	.945 1.149	1.140 .121	1.070 3.733	.049 -1.406

OVERALL PERFORMANCE

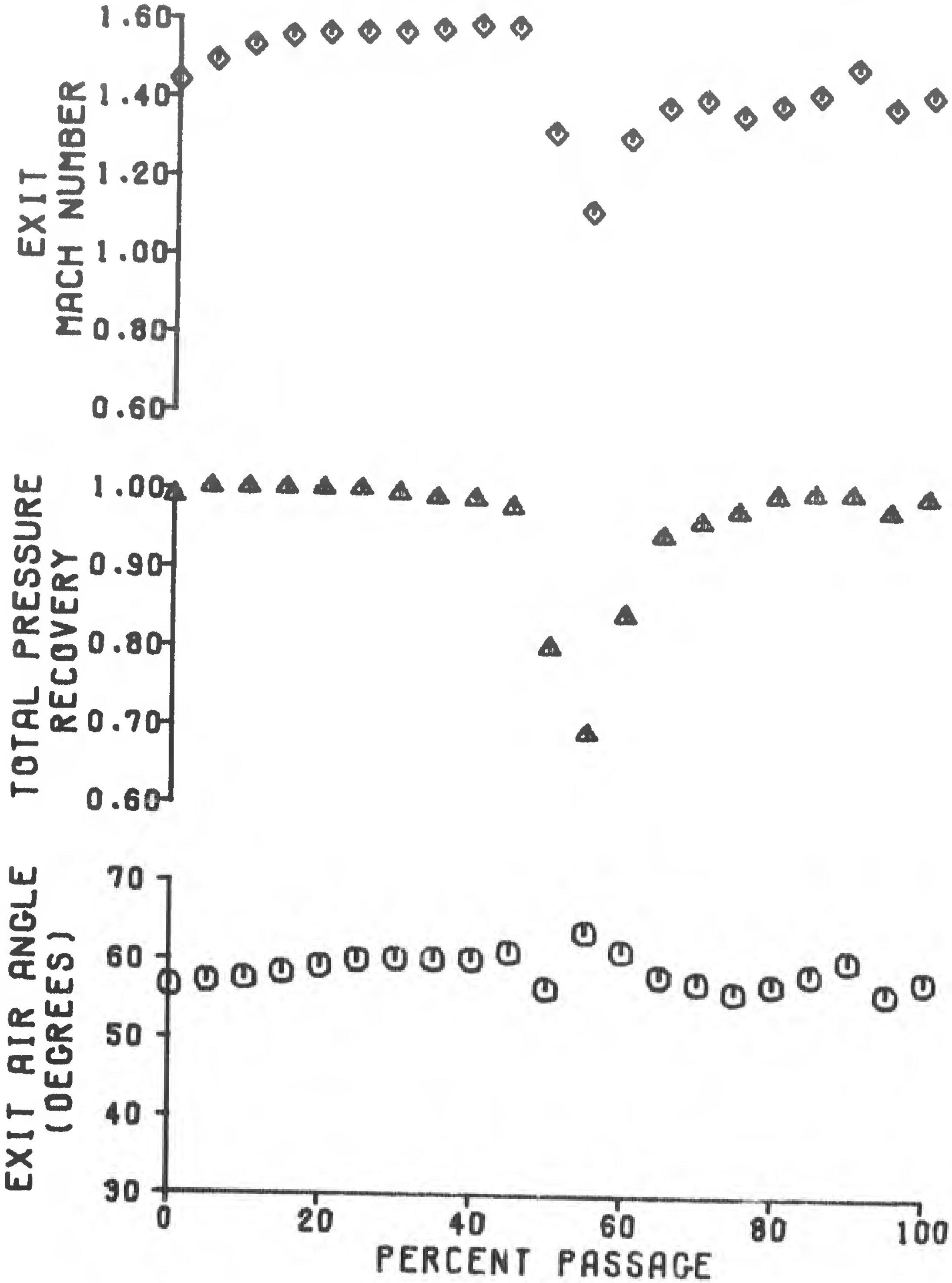
MIXED EXIT CONDITIONS

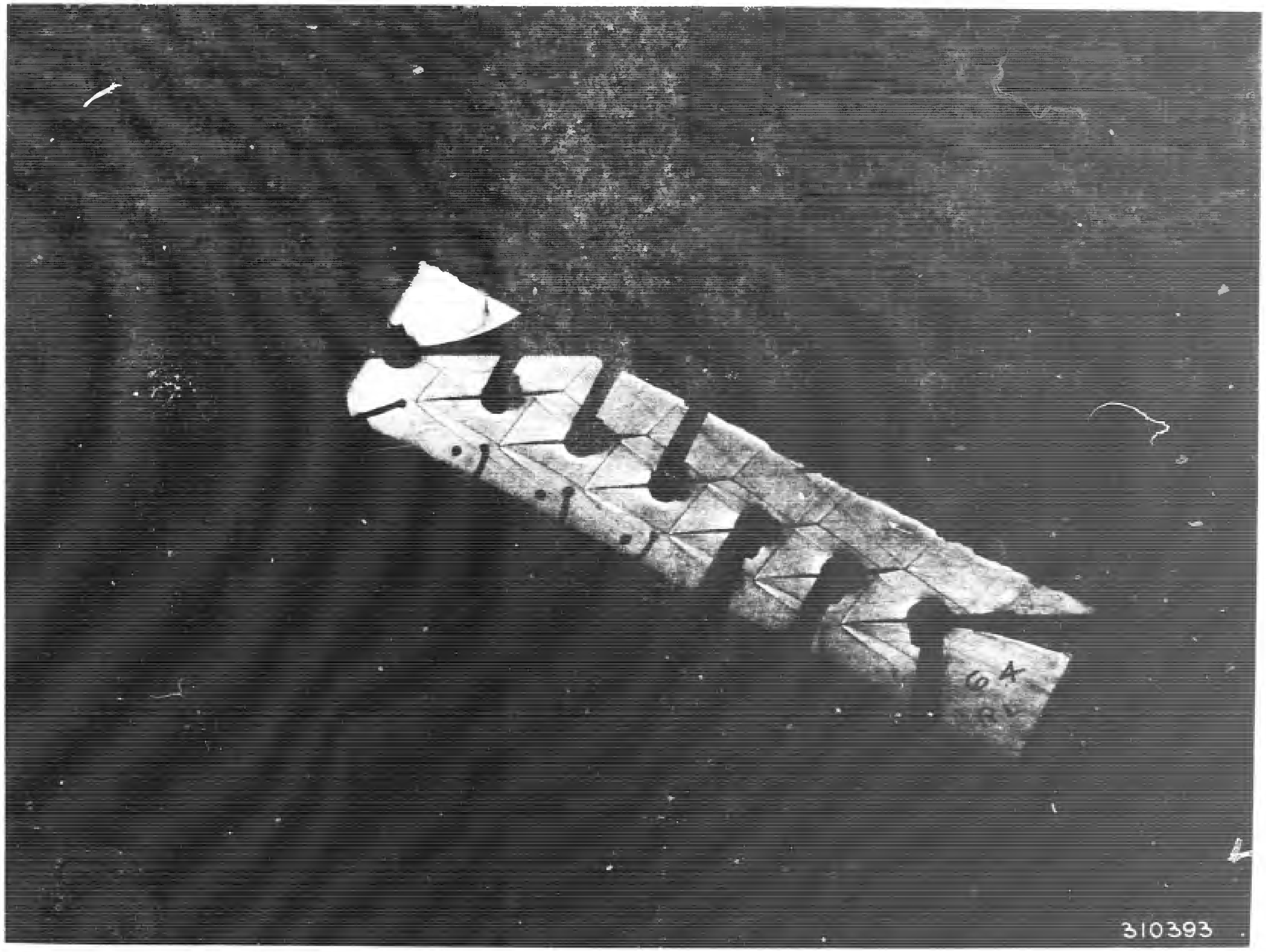
P)2/P)1 TPLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
1.232 .011 59.224	.952 .092 .957	.924 1.224	.877 .048	.943 1.140	1.144 .127	1.076 4.182	.063 -1.855


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
PRESSURE RISE COEFFICIENT(P-P1)/Q1
INLET MACH NUMBER = 1.616
STATIC PRESSURE RATIO = 1.220
0
20
40
60
80
100
PERCENT CHORD

SUPERSONIC COMPRESSOR CASCADE
AKL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.616
CASCADE STATIC PRESSURE RATIO = 1.220





CASCADE SCHLIEREN
MN)1 = 1.616, P)2/P)1 = 1.220

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.616	1.492	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.749	18.726	18.712	18.721
11	18.166	4.766	5.497	4.846
13	2.361	4.840	4.936	4.945
15	3.697	4.634	4.551	4.866
17	3.920	4.775	4.574	4.678
19	9.445	4.847	4.175	4.487
21	18.662	18.724	3.917	4.480
23	5.115	5.122	4.184	4.192
25	5.280	5.121	4.356	4.175
27	5.562	4.328	5.567	5.572
29	6.422	4.345	6.749	5.382
31	6.573	4.459	18.701	18.723
33	5.727	4.154	6.325	1.931
35	5.692	4.270	6.555	4.763
37	6.531	4.488	6.632	6.742
39	7.168	5.045	7.115	4.787
41	7.626	5.058	6.462	4.765
43	4.637	1.417	3.932	4.628
45	18.729	1.423	2.767	1.412
47	18.695	18.712	18.739	18.718

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.[illegible]	1.[illegible]	32.[illegible]	29.127	571.769

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MA1D	PT1D	TT1D	M1D	BETA1D
1.522	18.702	571.769	5.385	88.893

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.122	1.499
WEDGE	25	5.121	1.498
BLADE	27	4.328	1.612
BLADE	29	4.345	1.608
BLADE	31	4.459	1.591
BLADE	33	4.154	1.639
BLADE	35	4.270	1.610
BLADE	37	4.488	1.587

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION (DEG.)	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.522	-3.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
58.934	2.733	1.787	.025	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
58.947	53.797	52.432	54.993

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.616	18.702	571.769	57.258	4.296	.318	7.854

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/(P**6
3.453	5.218	.874	1.359	1.522	4.353	1.145

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	6.115	33	5.727
25	6.280	35	5.898
27	6.580	37	6.531
29	6.432	39	7.168
31	6.573	41	7.665

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
6.418	.181	6.894	.721	1.338	1.492

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	5.045	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.050	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.787	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.765	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.626	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	560.045	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.410	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.082	PSIA
SECONDARY BLEED FLOW RATE	=	.343	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.041	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	5.497	4.846	.153	.070	.294	.259	18.65	18.64
13	4.036	4.945	.081	.083	.264	.264	27.14	27.15
15	4.551	4.966	.032	.073	.243	.260	35.64	35.64
17	4.574	4.678	.035	.040	.245	.250	44.09	44.12
19	4.175	4.487	-.015	.024	.223	.240	52.62	52.62
21	3.917	4.480	-.048	.023	.209	.240	61.11	61.10
23	4.184	4.192	-.014	-.013	.224	.224	69.57	69.61
25	4.356	4.175	.008	-.015	.233	.223	78.08	78.13
27	6.567	5.572	.289	.162	.351	.298	86.57	86.60
29	6.749	5.382	.312	.138	.361	.288	95.34	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.021	-.018	.011	-29.774	-.001	.021	.016	74.213

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	MN12 TURN P1TP	MN1X,2 M12 P1HP	MN1Y,2 DP11,2 P1KP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,A TT11
	6.100	1.344	.580	1.212	18.702	6.356	1.000	64.418
.00	9.405	-7.168	.007	.202	1350.013	18.737	18.667	18.702
	18.164	9.213	7.833	8.257	8.498	5.419	18.702	573.148
	6.180	1.335	.551	1.216	18.518	6.369	.990	65.623
4.98	10.700	-8.373	.014	.184	1343.541	18.716	18.671	18.694
	18.014	9.364	7.555	8.363	8.391	6.613	18.694	572.603
	6.278	1.321	.556	1.197	18.188	6.378	.973	65.024
9.96	10.007	-7.770	.014	.514	1333.111	18.707	18.656	18.682
	17.743	9.157	7.637	8.432	8.556	6.010	18.682	572.803
	6.368	1.352	.628	1.195	18.071	6.091	.966	62.288
15.00	7.365	-5.038	.015	.631	1354.480	18.710	18.631	18.671
	17.525	8.524	7.700	7.970	8.292	3.278	18.671	572.803
	6.457	1.389	.662	1.221	18.166	5.799	.971	61.509
19.98	6.586	-4.259	.015	.536	1382.764	18.743	18.683	18.711
	17.456	8.143	7.509	7.548	7.975	2.499	18.711	571.769
	6.546	1.434	.688	1.259	18.693	5.567	.995	61.325
24.96	6.402	-4.975	.015	.098	1415.164	18.723	18.668	18.692
	17.658	7.898	7.295	7.302	7.722	2.315	18.692	572.114
DELP PROBE -.197								
	6.637	1.463	.704	1.203	18.702	5.374	1.008	61.247
30.05	6.324	-3.997	.015	.008	1434.898	18.724	18.668	18.692
	17.776	7.745	7.155	7.285	7.536	2.237	18.692	572.114

DELP PROBE -.119

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	MN12 TURN P1TP	MN1X,2 M12 P1HP	MN1Y,2 DP11,2 P1KP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,A TT11
	6.726	1.474	.710	1.292	18.702	5.292	1.000	61.209
35.03	6.246	-3.959	.015	.200	1442.426	18.708	18.648	18.678
	17.650	7.616	7.036	7.076	7.415	2.209	18.678	572.803
	6.815	1.464	.684	1.295	18.516	5.337	.995	62.172
40.01	7.249	-4.922	.015	.086	1435.948	18.712	18.644	18.678
	17.511	7.744	6.921	7.109	7.372	3.162	18.678	572.459
	6.924	1.442	.685	1.267	18.377	5.455	.983	61.582
44.99	6.657	-4.332	.015	.325	1419.195	18.694	18.666	18.682
	17.414	7.843	7.183	7.261	7.351	2.570	18.680	572.803
	6.993	1.281	.623	1.119	17.218	6.374	.921	60.892
49.97	5.969	-3.642	.015	1.483	1303.019	18.719	18.652	18.685
	16.917	8.580	8.135	8.335	8.594	1.892	18.685	572.459
	7.083	1.163	.584	1.049	14.335	6.199	.757	64.349
55.01	9.426	-7.099	.014	4.366	1209.550	18.724	18.658	18.691
	14.275	8.798	7.783	7.896	8.315	5.349	18.691	573.148
	7.172	1.152	.555	1.009	13.907	6.184	.744	61.161
59.99	6.238	-3.911	.013	4.795	1200.018	18.703	18.637	18.670
	13.859	8.419	8.927	7.677	8.237	2.151	18.670	573.148
	7.261	1.226	.663	1.031	16.265	6.489	.871	57.268
64.97	2.345	-.018	.015	2.417	1260.101	18.719	18.657	18.688
	16.123	8.329	8.709	8.305	8.697	-1.742	18.688	572.803

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y / DEV / PT)YP	MN)2 / TURN / P)TP	MN)X,2 / M)2 / P)BP	MN)Y,2 / DP)1,2 / P)NP	PT)2 / V)2 / P)SP	P)2 / PT)0 / BETA)P	PT)2/PT)1 / PT)0 / PT)1	BETA)2 / PT)0,A / TT)1
	7.351	1.273	.670	1.077	17.835	6.677	.954	57.781
70.01	2.859	-.531	.018	.867	1296.601	18.731	18.658	18.694
	17.545	8.623	8.919	8.605	9.062	-1.219	18.694	572.114
	7.440	1.256	.656	1.071	18.183	6.967	.972	58.522
74.99	3.590	-1.272	.018	.516	1283.265	18.714	18.673	18.693
	17.934	9.271	9.191	9.223	9.378	-.488	18.693	573.148
	7.529	1.240	.617	1.075	18.250	7.142	.976	60.165
79.97	5.242	-2.915	.018	.452	1272.865	18.696	18.660	18.678
	18.038	9.485	9.198	9.310	9.522	1.165	18.678	573.148
	7.619	1.262	.581	1.121	18.324	6.959	.960	62.603
85.00	7.680	-5.353	.017	.377	1288.417	18.710	18.671	18.690
	18.056	9.572	8.675	9.262	9.125	3.593	18.690	572.114
	7.728	1.239	.639	1.061	18.253	7.151	.976	58.951
89.98	4.028	-1.701	.017	.449	1270.212	18.723	18.674	18.698
	18.043	9.506	9.515	9.176	9.433	-.249	18.698	572.114
	7.797	1.224	.598	1.066	18.137	7.248	.970	60.747
94.96	5.824	-3.497	.017	.564	1255.385	18.739	18.644	18.691
	17.961	9.720	9.299	9.331	9.564	1.727	18.691	572.803
	7.887	1.263	.610	1.126	18.476	6.827	.988	61.586
100.00	6.663	-4.336	.017	.226	1304.050	18.718	18.652	18.685
	18.146	9.344	8.593	8.910	9.066	2.576	18.685	572.114

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
1.315	61.204	.953

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.633	1.152	17.829	6.307	571.769	1.346	.985

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.624	1.148	17.651	6.312	571.769	1.342	1.307	61.471

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

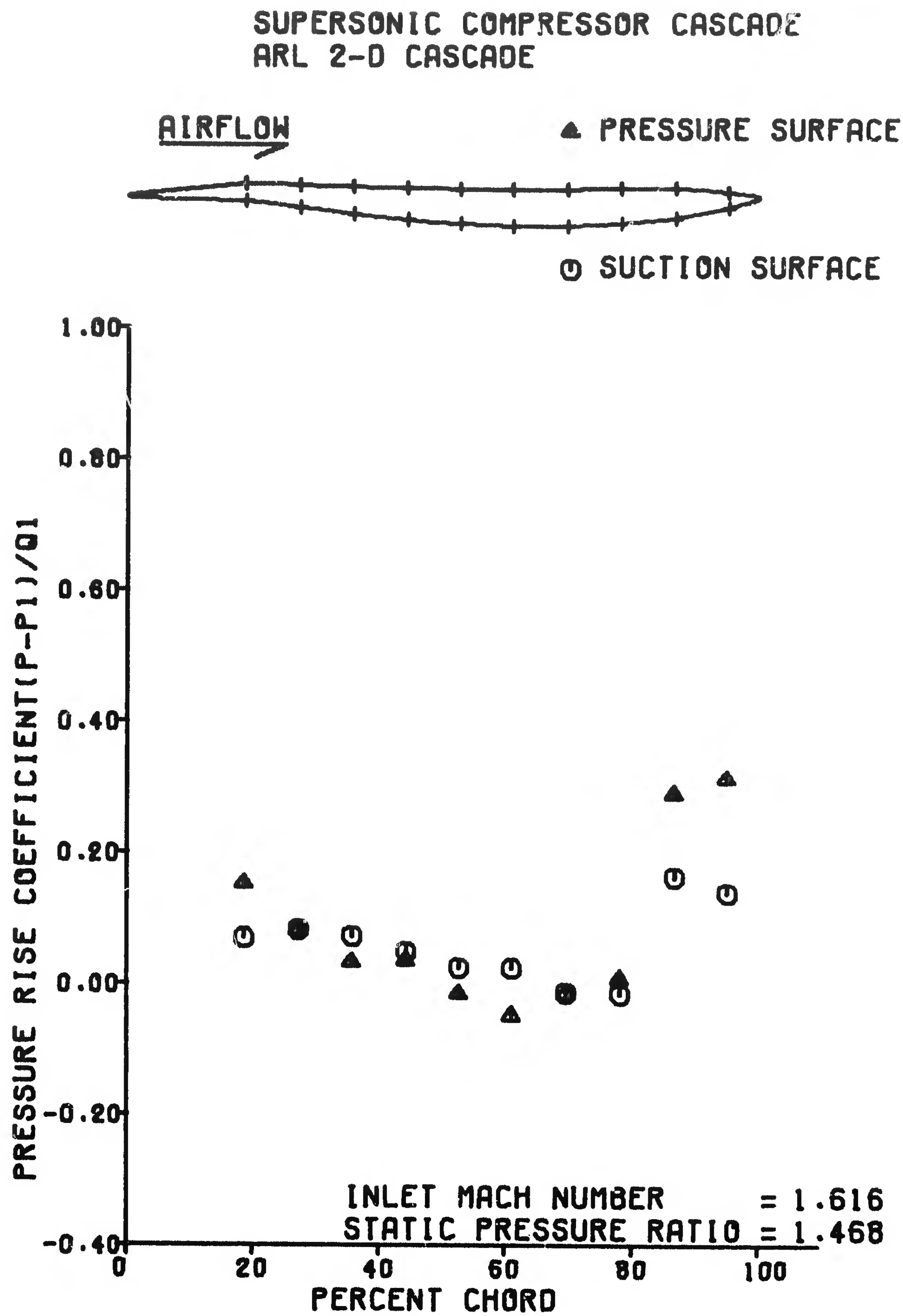
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.468	.953	.865	.770	.902	1.298	1.131	.061
.010	.162	1.315	.083	1.172	.256	6.281	-3.954
61.198	1.000						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

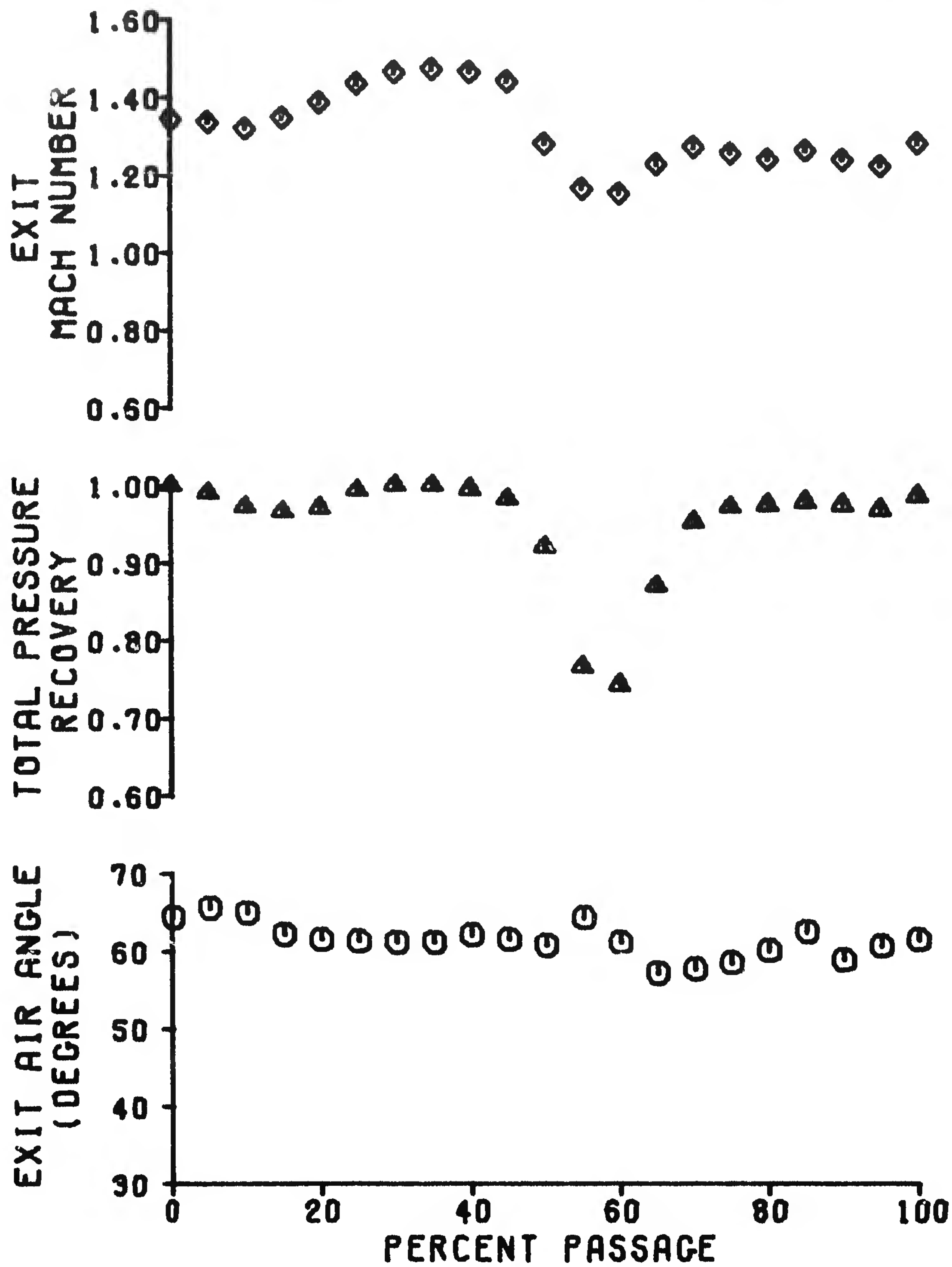
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.469	.944	.861	.760	.900	1.295	1.135	.073
.011	.166	1.321	.084	1.161	.257	6.548	-4.221
60.992	1.016						



SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
▲ PRESSURE SURFACE
SUCTION SURFACE
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
PRESSURE RISE COEFFICIENT(P-P1)/Q1
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.616
STATIC PRESSURE RATIO = 1.468

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.616
CASCADE STATIC PRESSURE RATIO = 1.468



CASCADE SCHLIEREN
M)1 = 1.616, P)2/P)1 = 1.468

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE TOTAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.615	1.562	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.674	18.661	18.642	18.668
11	17.854	4.749	5.499	4.844
13	8.654	4.829	4.930	4.939
15	3.991	4.612	4.539	4.863
17	8.215	4.763	4.569	4.672
19	4.420	4.827	4.187	4.485
21	18.590	18.639	4.386	4.476
23	6.637	5.079	4.670	4.181
25	7.035	5.098	6.192	4.242
27	7.270	4.381	7.728	5.527
29	7.284	4.357	8.107	5.325
31	7.406	4.424	18.625	18.624
33	5.485	4.139	6.747	3.585
35	5.582	4.272	7.048	6.157
37	7.457	4.484	7.071	7.251
39	7.239	5.824	7.537	4.767
41	7.596	5.825	4.420	4.760
43	4.516	1.298	4.035	4.620
45	18.623	1.307	2.864	1.296
47	18.621	18.640	18.651	18.645

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.893	1.501	31.000	29.326	572.883

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN10	PT10	TT10	M10	BETA10
1.500	18.628	572.803	8.345	58.674

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.079	1.499
WEDGE	25	5.098	1.497
BLADE	27	4.381	1.613
BLADE	29	4.357	1.604
BLADE	31	4.424	1.594
BLADE	33	4.139	1.638
BLADE	35	4.272	1.617
BLADE	37	4.484	1.584

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	-3.410	38.247	1.615	1.000	.844

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
56.934	2.733	1.787	.925	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
54.947	53.797	52.932	54.923

CASCADE INLET CONDITIONS

MN11	PT11	TT11	BETA11	P11	M11	Q11
1.615	18.628	572.893	57.258	4.284	.317	7.825

I1SS	I1ML	MN1X,1	MN1Y,1	TT/T11	PT/P11	NR/10**6
3.453	5.218	.974	1.359	1.522	4.349	1.138

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	6.637	33	6.[illegible]85
25	7.036	35	6.682
27	7.278	37	7.457
29	7.284	39	7.239
31	7.496	41	7.596

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
7.145	.293	7.092	.435	1.255	1.668

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	5.024	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.026	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.767	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.760	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.620	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	556.941	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.296	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.062	PSIA
SECONDARY BLEED FLOW RATE	=	.290	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.035	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	OPS/Q1 (PS)	OPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	5.400	4.544	.155	.072	.293	.260	18.65	18.64
13	4.930	4.939	.083	.084	.265	.265	27.14	27.15
15	4.539	4.863	.233	.074	.244	.261	35.64	35.64
17	4.569	4.672	.236	.050	.245	.251	44.09	44.12
19	4.187	4.485	-.012	.026	.225	.241	52.62	52.62
21	4.386	4.476	.013	.025	.235	.240	61.11	61.10
23	4.670	4.181	.349	-.013	.251	.224	69.57	69.61
25	6.192	4.242	.244	-.005	.332	.228	78.08	78.13
27	7.728	5.527	.440	.159	.415	.297	86.57	86.60
29	8.107	5.325	.489	.133	.435	.286	95.04	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.276	-.255	.141	-32.049	-.001	.076	.060	79.102

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	6.100 8.374 17.708	1.315 -6.047 9.365	.591 .000 7.997	1.174 .490 8.278	18.129 1329.460 8.645	6.414 18.665 4.287	.973 18.597 18.631	63.297 18.631 572.114
4.98	6.189 8.580 17.714	1.320 -6.253 9.058	.589 .015 7.927	1.181 .475 8.204	18.153 1333.477 8.617	6.376 18.566 4.493	.975 18.590 18.628	63.503 18.628 572.114
9.96	6.278 8.470 17.740	1.331 -6.143 8.980	.596 .015 7.869	1.190 .406 8.124	18.223 1342.070 8.497	6.308 18.660 4.393	.978 18.587 18.623	63.393 18.623 571.769
15.00	6.368 8.516 17.756	1.340 -6.280 8.948	.597 .015 7.795	1.220 .356 8.070	18.272 1348.707 8.385	6.240 18.688 4.539	.981 18.617 18.653	63.539 18.653 571.769
19.98	6.457 8.796 17.740	1.342 -6.469 8.945	.594 .015 7.748	1.204 .365 8.048	18.264 1350.157 8.359	6.220 18.663 4.709	.980 18.608 18.635	63.719 18.635 571.769
24.96	6.546 7.945 17.672	1.327 -5.618 8.919	.605 .015 7.950	1.181 .491 8.121	18.137 1338.988 8.502	6.306 18.639 3.850	.974 18.602 18.621	62.868 18.621 572.459
30.05	6.637 7.364 17.668	1.301 -5.037 9.043	.605 .016 8.229	1.152 .585 8.356	18.043 1319.188 8.778	6.563 18.665 3.277	.969 18.597 18.631	62.287 18.631 571.769

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
35.03	6.726 5.016 17.710	1.257 -2.689 9.257	.630 .015 9.031	1.288 .667 8.970	17.951 1285.777 8.978	6.866 18.666 .929	.964 18.640 18.653	59.939 18.653 572.459
40.01	6.815 4.043 17.691	1.182 -1.716 9.978	.612 .017 9.886	1.213 .837 9.713	17.791 1226.158 10.126	7.507 18.655 -.034	.955 18.606 18.631	58.966 18.631 573.148
44.99	6.904 5.500 17.590	1.171 -4.173 10.267	.560 .017 9.703	1.028 .955 9.856	17.673 1216.746 10.327	7.570 18.670 2.413	.949 18.604 18.637	61.423 18.637 571.769
49.97	6.993 6.881 16.783	1.133 -4.554 10.287	.535 .016 9.673	.999 1.806 9.821	16.823 1185.610 10.172	7.561 18.673 2.804	.903 18.590 18.631	61.804 18.631 572.803
55.01	7.083 6.043 15.064	.848 -4.516 10.123	.400 .015 9.684	.740 3.564 9.625	15.064 930.265 9.901	9.411 18.636 2.856	.809 18.610 18.623	61.865 18.623 572.459
59.99	7.172 3.657 14.138	.774 -1.330 9.815	.403 .014 9.868	.660 4.400 9.493	14.138 857.898 9.781	9.516 18.669 -.410	.759 18.593 18.631	58.580 18.631 571.769
64.97	7.261 1.490 15.130	.874 .837 9.557	.484 .015 9.967	.728 3.498 9.485	15.130 955.239 9.758	9.196 18.671 -2.587	.812 18.599 18.635	56.413 18.635 573.168

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)9P	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.01	7.351 2.220 17.043	1.175 .107 9.449	.638 .017 9.470	.987 1.499 9.503	17.130 1220.596 9.800	7.292 18.653 -1.867	.920 18.588 18.621	57.143 18.621 571.424
74.99	7.440 3.682 17.958	1.223 -1.355 9.433	.637 .018 9.529	1.044 .496 9.423	18.132 1258.657 9.677	7.257 18.673 -.395	.973 18.615 18.644	58.805 18.644 572.114
79.97	7.529 5.305 18.118	1.261 -3.068 9.335	.624 .018 9.009	1.096 .244 9.147	18.384 1288.587 9.331	6.994 18.657 1.308	.987 18.606 18.632	60.318 18.632 571.769
85.00	7.619 6.346 18.072	1.292 -4.319 9.191	.621 .017 8.623	1.133 .292 8.781	18.426 1312.139 8.953	6.726 18.650 2.249	.989 18.620 18.635	61.269 18.635 571.769
89.98	7.728 5.650 17.943	1.302 -3.323 8.948	.640 .017 8.552	1.134 .300 8.604	18.328 1320.038 8.821	6.596 18.564 1.573	.984 18.611 18.637	60.573 18.637 572.459
94.96	7.707 6.064 17.913	1.322 -3.737 8.804	.641 .017 8.301	1.156 .263 8.436	18.365 1334.888 8.627	6.434 18.652 1.987	.986 18.615 18.633	60.987 18.633 573.148
100.00	7.887 6.251 17.861	1.343 -3.934 8.647	.647 .016 8.091	1.176 .239 8.199	18.390 1350.418 8.425	6.260 18.667 2.184	.987 18.597 18.632	61.184 18.632 572.803

194

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
1.289	60.875	.943

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.588	1.056	17.572	7.165	572.803	1.292	1.018

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.570	1.048	17.367	7.226	572.804	1.285	1.193	61.489

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

OVERALL PERFORMANCE

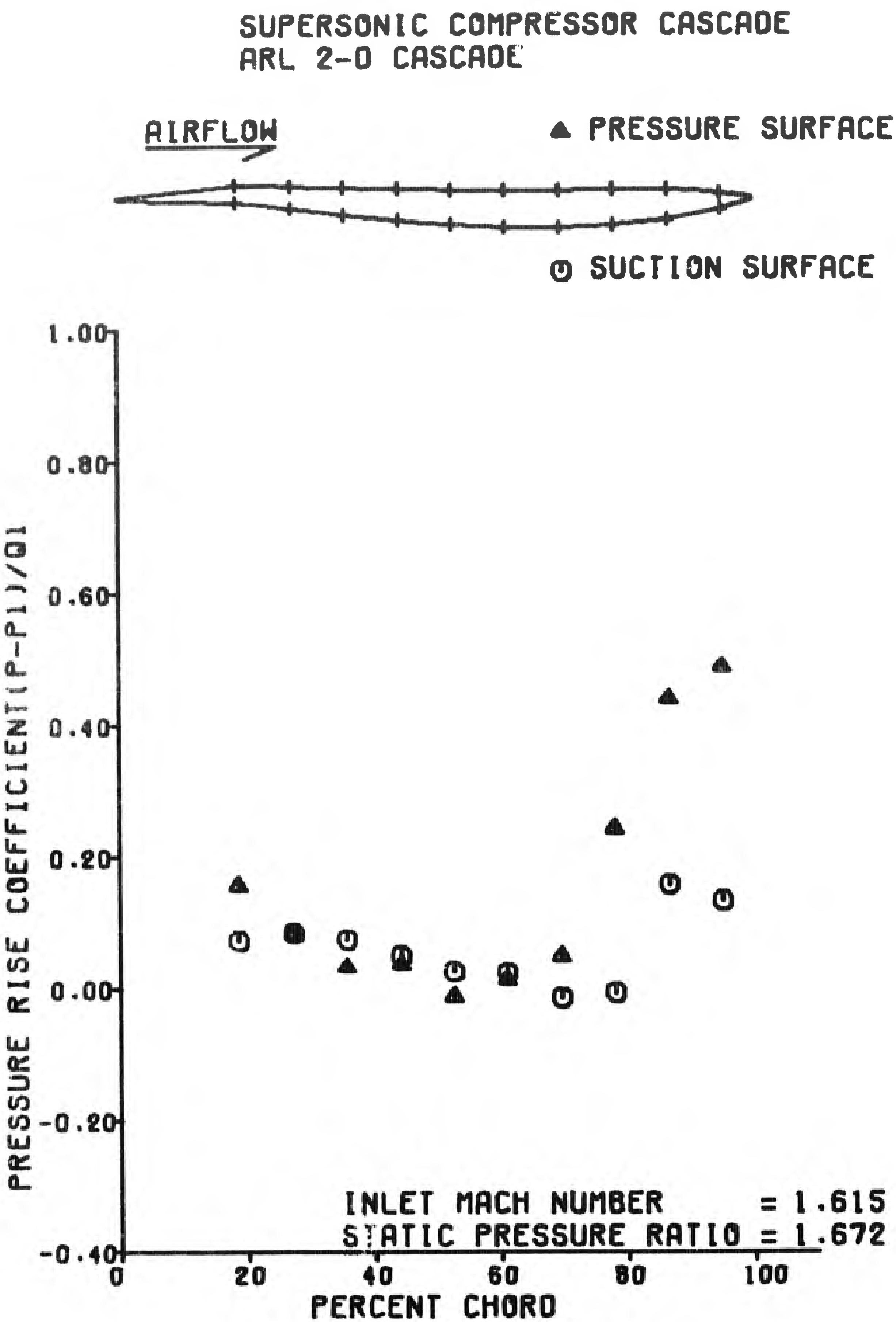
MASS AVERAGED EXIT CONDITIONS

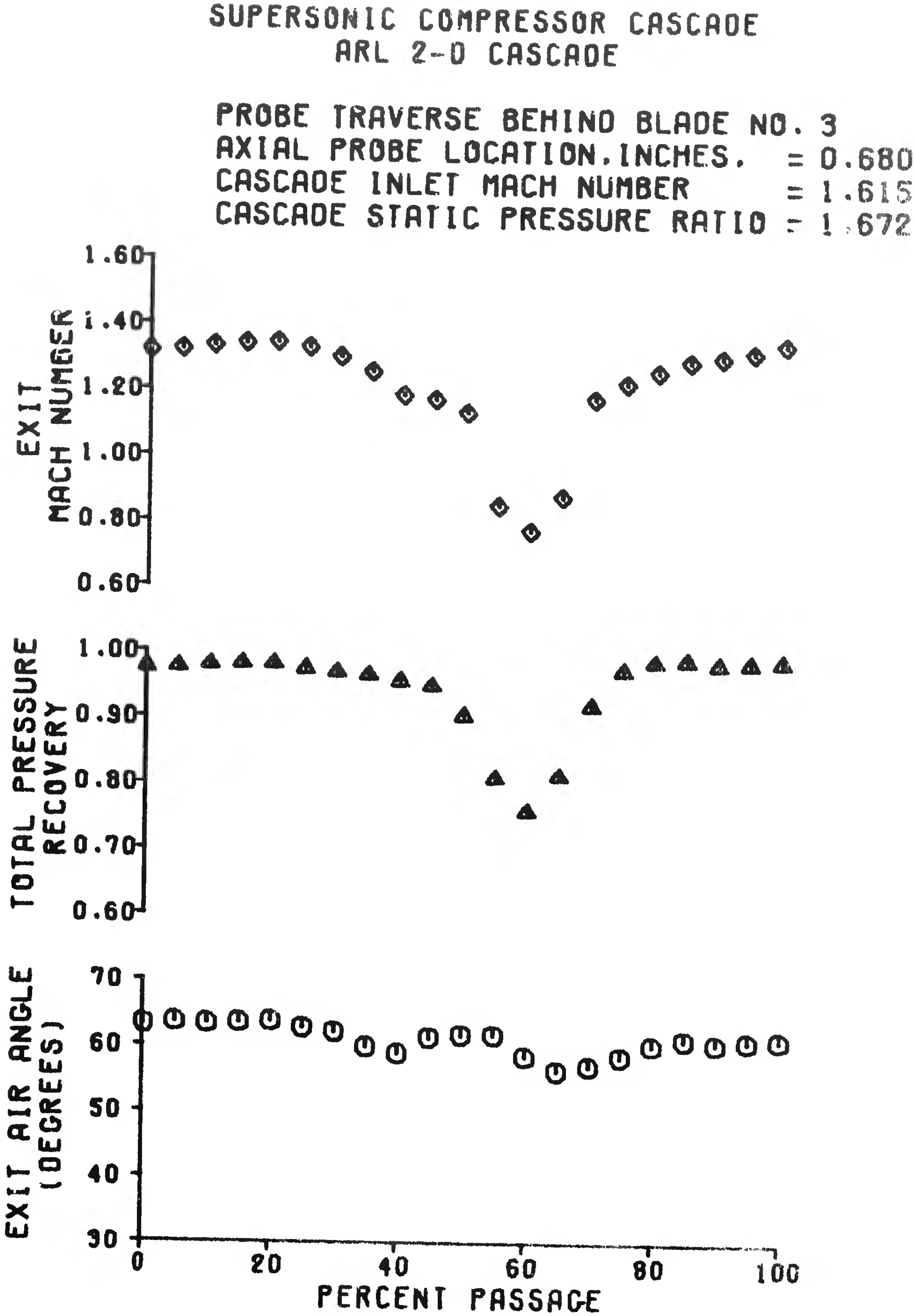
P)2/P)1 TPLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y MN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
1.672 .012 62.021	.943 .231 .964	.812 1.414	.731 .132	.843 1.161	1.420 .368	1.178 5.952	.074 -3.625

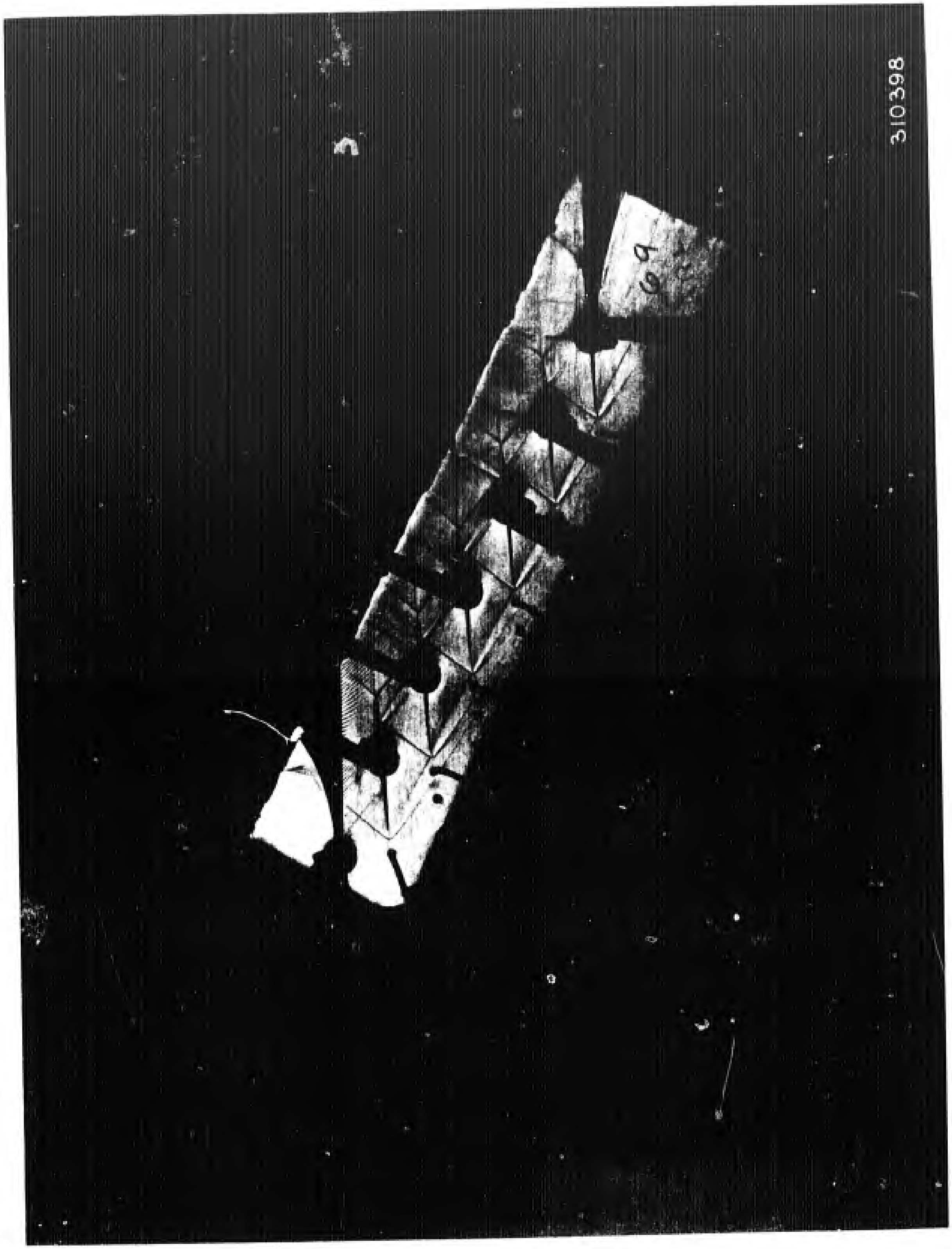
OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P)2/P)1 TPLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y MN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
1.687 .014 61.798	.932 .240 .990	.804 1.429	.709 .135	.840 1.147	1.424 .376	1.185 6.566	.088 -4.239


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
▲ PRESSURE SURFACE
⊙ SUCTION SURFACE
PRESSURE RISE COEFFICIENT(P-P1)/Q1
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.615
STATIC PRESSURE RATIO = 1.672


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION.INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.615
CASCADE STATIC PRESSURE RATIO = 1.672
EXIT MACH NUMBER
1.60
1.40
1.20
1.00
0.80
0.60
TOTAL PRESSURE RECOVERY
1.00
0.90
0.80
0.70
0.60
EXIT AIR ANGLE (DEGREES)
70
60
50
40
30
0
20
40
60
80
100
PERCENT PASSAGE



CASCADE SCHLIEREN

MN)1 = 1.616, P)2/P)1 = 1.672

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.614	1.996	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.493	18.492	18.402	18.500
11	17.461	4.705	5.540	4.755
13	18.492	4.785	4.865	4.894
15	18.456	4.569	4.762	4.813
17	18.382	4.710	5.030	4.627
19	18.648	4.782	5.438	4.453
21	18.443	18.498	6.615	4.433
23	7.924	5.034	7.462	4.158
25	7.968	5.054	8.198	4.241
27	8.033	4.264	8.309	5.432
29	8.103	4.363	7.921	5.274
31	8.233	4.376	18.512	18.499
33	6.740	4.109	7.732	3.741
35	7.849	4.238	7.897	7.075
37	8.207	4.450	8.107	8.107
39	8.119	4.988	8.301	4.727
41	7.653	4.962	4.407	4.717
43	4.581	1.292	3.937	4.577
45	18.488	1.296	2.766	1.289
47	18.507	18.502	18.521	18.530

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.880	1.501	30.990	29.321	571.769

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MNJO	PTJO	TTJO	MJO	BETAJO
1.500	18.491	571.765	6.288	60.679

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.034	1.500
WEDGE	25	5.054	1.497
BLADE	27	4.264	1.613
BLADE	29	4.363	1.598
BLADE	31	4.376	1.596
BLADE	33	4.109	1.638
BLADE	35	4.238	1.617
BLADE	37	4.450	1.584

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	-3.420	38.237	1.616	1.000	.844

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
58.934	2.733	1.787	.025	1.000	1.000

INLET METAL ANGLE (DEGREES) PS	SS	ML	EXIT METAL ANGLE ML (DEG.)
58.947	53.797	52.832	54.923

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.616	18.481	571.769	57.258	4.248	.315	7.762

I)SS	Y)ML	MN)X.1	MN)Y.1	TT/T)1	PT/P)1	NR/10**6
3.453	5.218	.874	1.359	1.522	4.351	1.132

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	7.984	33	6.740
25	7.968	35	7.849
27	8.033	37	8.207
29	8.183	39	8.119
31	8.233	41	7.653

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
8.248	.114	7.714	.527	1.158	1.895

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	4.980	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	4.982	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.727	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.717	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.577	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	555.007	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.289	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.260	PSIA
SECONDARY BLEED FLOW RATE	=	.286	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.034	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	5.540	4.795	.166	.070	.302	.259	18.65	18.84
13	4.865	4.894	.080	.083	.263	.265	27.14	27.15
15	4.762	4.813	.066	.073	.258	.260	35.64	35.64
17	5.030	4.627	.101	.049	.272	.250	44.09	44.12
19	5.438	4.453	.153	.026	.294	.241	52.52	52.62
21	6.615	4.433	.305	.024	.358	.240	61.11	61.10
23	7.462	4.158	.414	-.012	.404	.225	69.57	69.61
25	8.198	4.241	.509	-.001	.444	.229	78.08	78.13
27	8.309	5.432	.523	.153	.450	.294	86.57	86.60
29	7.921	5.274	.473	.132	.429	.285	95.04	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.185	-.158	.100	-32.586	-.002	.185	.131	70.919

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	6.100 4.207 17.755	1.114 -1.970 10.737	.570 .000 10.689	.957 .699 10.590	17.782 1160.799 10.800	6.183 18.528 .210	.962 18.428 18.478	59.220 18.478 570.398
4.98	6.189 3.758 17.707	1.088 -1.131 10.748	.566 .018 10.822	.929 .761 10.637	17.720 1146.634 10.844	8.424 18.508 -.329	.959 18.464 18.486	58.881 18.486 572.459
9.96	6.278 3.759 17.812	1.115 -1.432 10.567	.579 .018 10.740	.952 .641 10.587	17.840 1169.241 10.835	8.204 18.525 -.318	.965 18.458 18.492	58.682 18.492 572.114
15.00	6.388 3.969 18.125	1.152 -1.642 10.552	.595 .018 10.581	.986 .294 10.442	18.187 1200.145 10.748	7.981 18.531 -.118	.984 18.458 18.490	58.892 18.490 572.459
19.98	6.457 4.301 18.114	1.163 -1.974 10.450	.595 .018 10.390	.990 .291 10.308	18.189 1209.550 10.615	7.886 18.531 .214	.984 18.448 18.486	59.224 18.486 572.114
24.96	6.546 4.652 18.105	1.174 -2.325 10.339	.595 .018 10.201	1.012 .286 10.130	18.195 1218.398 10.458	7.759 18.501 .575	.985 18.467 18.484	59.575 18.484 572.114
30.05	6.837 5.207 18.034	1.164 -2.970 10.178	.588 .018 9.884	1.028 .343 9.922	18.138 1226.549 10.233	7.638 18.514 1.220	.981 18.465 18.490	60.220 18.490 572.114

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
35.03	6.726 5.759 17.844	1.191 -3.432 10.265	.583 .017 9.665	1.038 .522 9.746	17.958 1232.108 10.022	7.493 18.517 1.682	.972 18.459 18.488	60.682 18.488 572.459
40.01	6.815 5.988 17.077	1.176 -3.861 9.865	.572 .017 9.430	1.028 1.316 9.565	17.165 1219.873 9.810	7.383 18.507 1.911	.929 18.450 18.478	60.911 18.478 572.114
44.99	6.904 6.245 15.891	1.124 -3.918 9.752	.542 .016 9.304	.984 2.558 9.408	15.923 1176.885 9.623	7.239 18.508 2.168	.862 18.456 18.482	61.188 18.482 572.114
49.97	6.993 5.834 14.589	.863 -3.507 9.687	.422 .014 9.342	.753 3.892 9.307	14.589 943.863 9.459	8.972 18.551 1.747	.789 18.483 18.517	60.757 18.517 571.769
55.01	7.083 3.706 13.855	.794 -1.379 9.453	.413 .014 9.503	.678 4.626 9.230	13.855 877.175 9.403	9.142 18.514 -.381	.750 18.440 18.477	58.629 18.477 571.769
59.99	7.172 1.528 14.460	.846 .799 9.327	.467 .015 9.702	.705 4.021 9.306	14.460 927.332 9.478	9.054 18.503 -2.559	.782 18.469 18.486	56.451 18.486 572.114
64.97	7.261 2.118 16.196	1.143 .209 9.385	.622 .016 9.801	.959 2.237 9.448	16.243 1192.558 9.670	7.211 18.519 -1.969	.879 18.458 18.485	57.841 18.485 572.459

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
	7.351	1.192	.629	1.012	17.590	7.331	.952	58.155
70.01	3.232	-.905	.018	.891	1232.785	18.508	18.480	18.494
	17.477	9.500	9.700	9.543	9.780	-.655	18.494	572.114
	7.440	1.198	.611	1.031	17.865	7.385	.957	59.366
74.99	4.443	-2.116	.018	.616	1237.876	18.533	18.490	18.511
	17.740	9.693	9.600	9.578	9.793	.356	18.511	572.114
	7.529	1.186	.599	1.023	17.848	7.499	.966	59.641
79.97	4.718	-2.391	.017	.633	1227.726	18.523	18.440	18.482
	17.742	9.959	9.897	9.746	9.936	.641	18.482	572.459
	7.619	1.153	.603	.983	17.720	7.760	.959	58.500
85.00	3.577	-1.250	.018	.761	1201.450	18.494	18.461	18.477
	17.658	10.247	10.365	10.136	10.400	-.510	18.477	572.459
	7.708	1.124	.581	.962	17.632	8.015	.954	58.852
89.98	3.020	-1.602	.018	.849	1176.988	18.514	18.474	18.494
	17.597	10.540	10.576	10.416	10.652	-.158	18.494	572.114
	7.797	1.117	.574	.958	17.640	8.093	.955	59.084
94.96	4.161	-1.834	.018	.840	1170.903	18.535	18.467	18.501
	17.611	10.606	10.587	10.502	10.714	.084	18.501	572.803
	7.887	1.119	.578	.959	17.534	8.019	.949	58.950
100.00	4.007	-1.880	.018	.947	1172.956	18.524	18.436	18.480
	17.503	10.469	10.487	10.441	10.628	-.080	18.480	572.459

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
1.112	59.157	.932

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.570	.955	17.218	7.[illegible]	571.769	1.247	1.086

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.559	.951	17.104	7.974	571.[illegible]	1.244	1.104	59.544

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

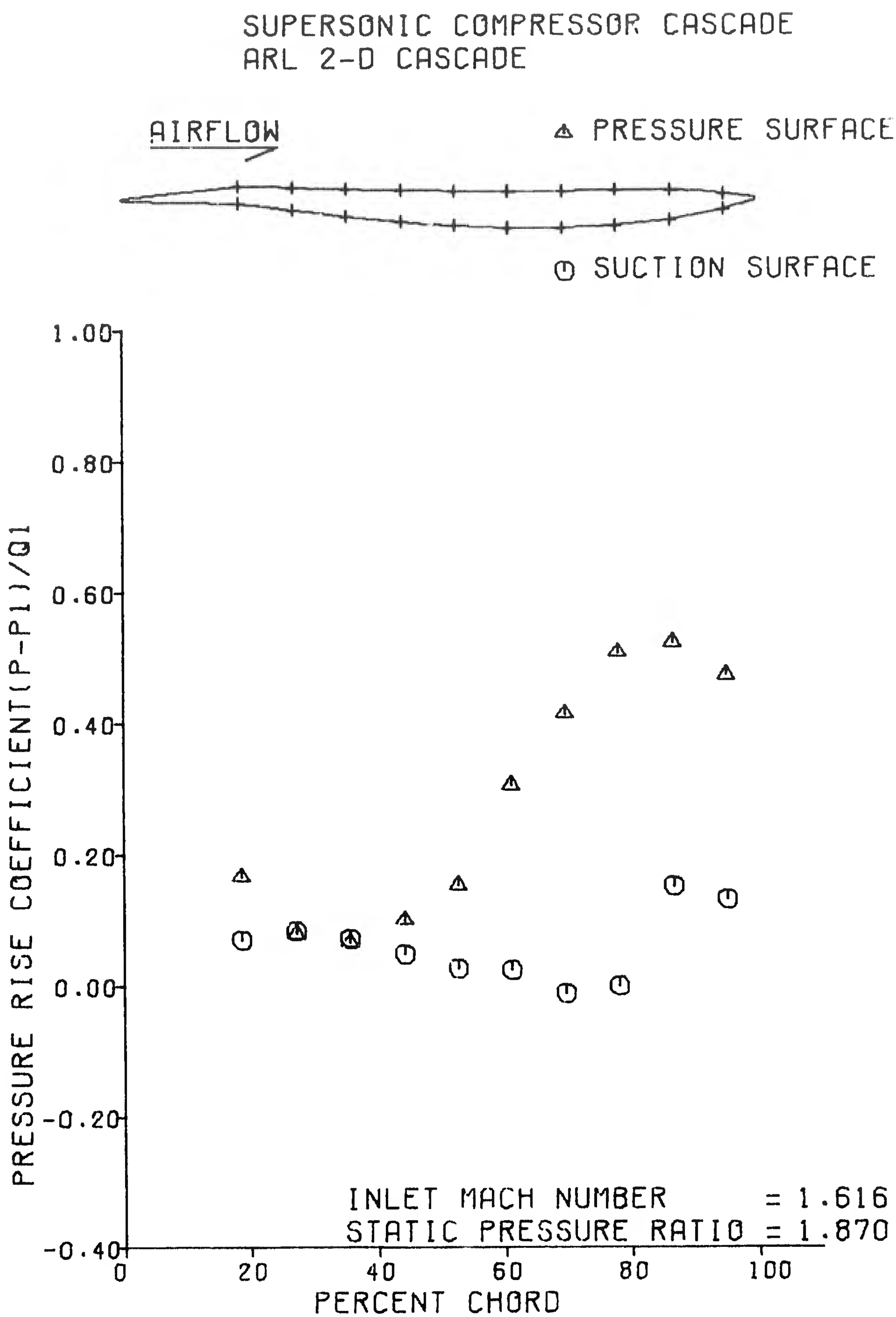
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.870	.932	.760	.721	.776	1.532	1.220	.089
.015	.301	1.526	.188	1.136	.476	4.234	-1.907
62.336	.906						

OVERALL PERFORMANCE

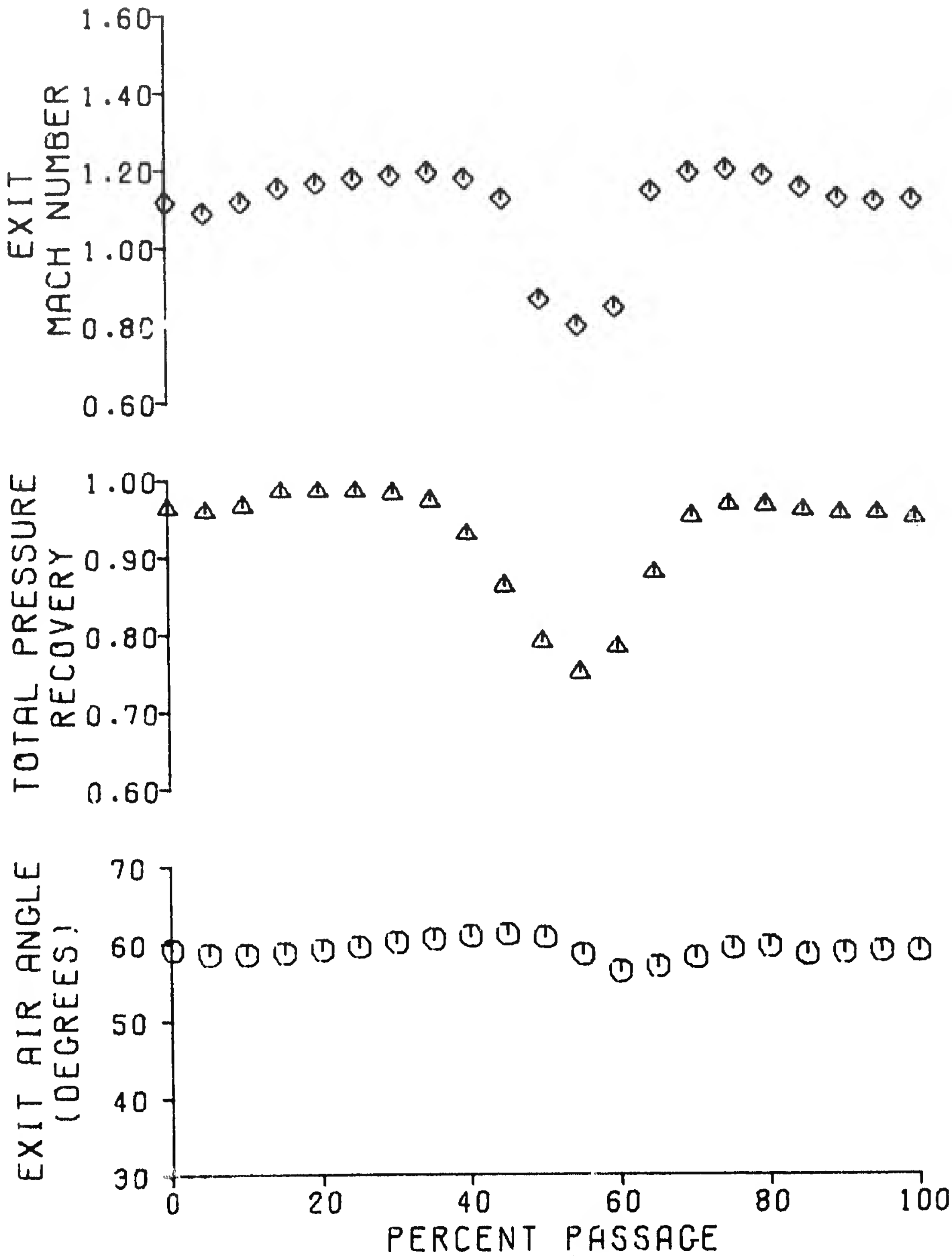
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.877	.926	.756	.708	.775	1.534	1.224	.097
.016	.306	1.536	.190	1.127	.480	4.621	-2.294
62.179	.921						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
PRESSURE RISE COEFFICIENT(P-P1)/Q1
INLET MACH NUMBER = 1.616
STATIC PRESSURE RATIO = 1.870
0
20
40
60
80
100
PERCENT CHORD

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES, = 0.680
CASCADE INLET MACH NUMBER = 1.616
CASCADE STATIC PRESSURE RATIO = 1.870



CASCADE SCHLIEREN

MN)1 = 1.616, P)2/P)1 = 1.870

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.616	2.198	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.521	18.514	18.484	18.514
11	17.020	4.713	6.864	4.763
13	13.475	4.791	7.763	4.851
15	11.096	4.509	7.960	4.785
17	[illegible]	4.726	9.037	4.624
19	10.846	4.780	9.864	4.568
21	18.449	18.495	9.677	4.921
23	9.254	5.041	9.372	6.089
25	9.302	5.060	9.038	7.264
27	9.328	4.275	8.289	7.954
29	9.365	4.590	8.322	8.692
31	9.366	4.347	18.510	18.528
33	9.048	4.311	9.358	3.090
35	9.246	6.107	9.420	7.724
37	9.329	6.273	9.696	9.738
39	9.320	4.992	9.881	4.607
41	9.507	4.990	4.355	4.528
43	4.514	1.461	3.786	3.908
45	19.507	1.468	2.803	1.456
47	18.524	18.494	18.519	18.528

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.891	1.501	31.000	29.313	573.838

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MA1C	PT1C	TT1C	M1C	HETA1C
1.500	18.408	573.838	8.279	60.687

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.041	1.502
WEDGE	25	5.060	1.497
BLADE	27	4.276	1.612
BLADE	29	4.590	1.564
BLADE	31	4.347	1.601
BLADE	33	4.311	1.606
BLADE	35	6.107	1.365
BLADE	37	6.273	1.345

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO
1.502	-3.430	38.228	1.616	1.000

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
56.934	2.733	1.787	.025	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
50.947	53.737	52.032	54.923

CASCADE INLET CONDITIONS

MN)1	PT)	TT)1	BETA)1	P)1	M)1	Q)1
1.616	18.408	573.838	57.250	4.250	.314	7.769

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
3.453	5.218	.874	1.359	1.522	4.353	1.127

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.254	33	9.048
25	9.342	35	9.246
27	9.328	37	9.329
29	9.365	39	9.328
31	9.366	41	9.507

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
9.323	.042	9.290	.148	1.040	2.194

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	4.992	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	4.990	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.607	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.528	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	3.908	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	559.700	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.458	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.089	PSIA
SECONDARY BLEED FLOW RATE	=	.363	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.044	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	6.864	4.763	.337	.066	.371	.257	18.65	18.64
13	7.769	4.851	.453	.077	.420	.262	27.14	27.15
15	7.960	4.785	.478	.069	.430	.259	35.64	35.64
17	9.037	4.626	.616	.048	.489	.250	44.09	44.12
19	9.864	4.568	.723	.041	.533	.247	52.62	52.62
21	9.677	4.921	.699	.086	.523	.266	61.11	61.10
23	9.372	5.989	.659	.237	.507	.329	69.57	69.61
25	9.038	7.264	.616	.388	.489	.393	78.08	78.13
27	8.289	7.954	.520	.477	.448	.430	86.57	86.60
29	8.322	8.692	.524	.572	.450	.470	95.04	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.317	-.270	.166	-31.625	-.008	.317	.150	47.206

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN F)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)SP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	6.100 1.821 18.017	1.126 .506 10.555	.617 .000 11.082	.941 .444 10.635	18.054 1180.513 10.883	8.190 18.509 -2.256	.976 18.447 18.478	56.744 18.478 570.734
4.98	6.180 1.767 17.965	1.123 .560 10.544	.617 .019 11.080	.938 .468 10.641	18.029 1178.280 10.874	8.205 18.535 -2.310	.975 18.479 18.507	56.690 18.507 572.803
9.96	6.278 1.891 17.957	1.125 .436 10.538	.616 .019 11.047	.941 .505 10.601	17.993 1179.925 10.836	8.170 18.531 -2.195	.973 18.469 18.500	56.814 18.500 572.459
15.00	6.368 2.087 17.913	1.127 .240 10.504	.613 .019 10.965	.945 .551 10.555	17.947 1161.334 10.781	8.132 18.508 -1.998	.970 18.460 18.484	57.010 18.484 573.148
19.98	6.457 2.365 17.743	1.123 -.038 10.462	.607 .019 10.857	.945 .721 10.506	17.777 1173.171 10.718	8.093 18.521 -1.722	.961 18.442 18.482	57.288 18.482 571.424
24.96	6.545 3.026 17.810	1.142 -.699 10.421	.606 .019 10.668	.968 .637 10.422	17.861 1194.068 10.642	7.938 18.506 -1.061	.966 18.468 18.487	57.949 18.487 572.114
30.05	6.637 3.791 17.683	1.150 -1.464 10.308	.597 .019 10.375	.982 .756 10.258	17.742 1200.487 10.469	7.887 18.523 -.286	.959 18.475 18.499	58.714 18.499 572.803

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN F)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 F)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
35.03	6.726 4.541 16.904	1.122 -2.214 10.187	.570 .017 10.085	.967 1.562 10.020	16.936 1177.804 10.243	7.714 18.523 .464	.916 18.456 18.490	59.464 18.490 572.803
40.01	6.815 4.360 15.451	.872 -2.033 9.978	.446 .016 9.934	.750 3.047 9.775	15.451 954.381 9.959	9.409 18.524 .273	.835 18.450 18.487	59.283 18.487 571.769
44.99	6.904 2.721 14.572	.808 -.394 9.750	.432 .015 9.942	.683 3.926 9.609	14.572 892.311 9.825	9.484 18.524 -1.366	.788 18.465 18.495	57.644 18.495 571.424
49.97	6.993 .954 14.577	.811 1.373 9.583	.455 .015 10.024	.672 3.020 9.551	14.577 895.488 9.824	9.456 18.531 -3.123	.788 18.476 18.503	55.877 18.503 572.114
55.01	7.083 .048 15.042	.844 2.279 9.579	.484 .016 10.190	.691 3.455 9.640	15.042 927.041 9.964	9.439 18.517 -4.029	.813 18.466 18.491	54.971 18.491 572.803
59.99	7.172 -.344 15.616	.873 2.671 9.583	.505 .017 10.405	.711 2.880 9.806	15.618 954.781 10.132	9.506 18.528 -4.421	.844 18.461 18.495	54.579 18.495 572.459
64.97	7.261 -.519 16.298	.906 2.846 9.818	.527 .018 10.627	.737 2.290 9.978	16.298 985.973 10.314	9.521 18.512 -4.596	.876 18.474 18.493	54.404 18.493 572.114

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y / DEV / PT1YP	MN12 / TURN / P1TP	MN1X,2 / M12 / P1PP	MN1Y,2 / PP11,2 / P1SP	PT12 / V12 / F1SP	P12 / PT1P / BETA1P	PT12/PT11 / PT1C / PT11	BETA12 / PT1C,A / TT11
70.71	7.351 -.437 16.613	.924 2.764 9.962	.537 .212 12.704	.752 1.885 17.136	16.613 1003.276 18.455	9.554 18.512 -4.914	.898 18.468 18.489	54.486 18.489 571.769
74.00	7.449 -.330 16.084	.961 2.657 10.995	.557 .219 12.944	.793 1.514 17.261	16.084 1036.851 18.592	9.383 18.518 -4.427	.918 18.462 18.498	54.593 18.499 572.459
79.57	7.520 .331 17.330	1.084 1.306 10.190	.622 .219 11.213	.904 1.155 17.368	17.343 1148.763 18.678	8.244 18.507 -3.756	.938 18.459 18.483	55.254 18.483 571.769
85.00	7.619 .753 17.678	1.115 1.574 10.293	.626 .222 11.046	.922 .807 10.471	17.697 1171.249 18.761	8.142 18.507 -3.324	.957 18.462 18.484	55.678 18.484 571.769
89.98	7.728 .878 17.875	1.123 1.440 10.380	.631 .222 11.118	.929 .589 10.532	17.909 1178.148 18.813	8.153 18.528 -3.190	.968 18.473 18.500	55.891 18.500 572.114
94.96	7.797 1.238 17.839	1.117 1.380 10.437	.622 .229 11.289	.926 .520 10.565	17.869 1173.296 18.837	8.194 18.522 -2.939	.966 18.456 18.488	56.161 18.488 572.114
100.00	7.887 1.334 17.978	1.124 .903 10.481	.624 .220 11.116	.935 .485 10.619	18.013 1179.166 18.858	8.188 18.527 -2.743	.974 18.465 18.496	56.257 18.496 572.893

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN12	BETA12	PT12/PT11
1.231	56.498	.919

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	M12/M11
.571	.859	16.904	8.653	573.838	1.213	1.163

MIXED EXIT CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	MN12	BETA12
.558	.855	16.877	8.700	573.838	1.208	1.221	56.898

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

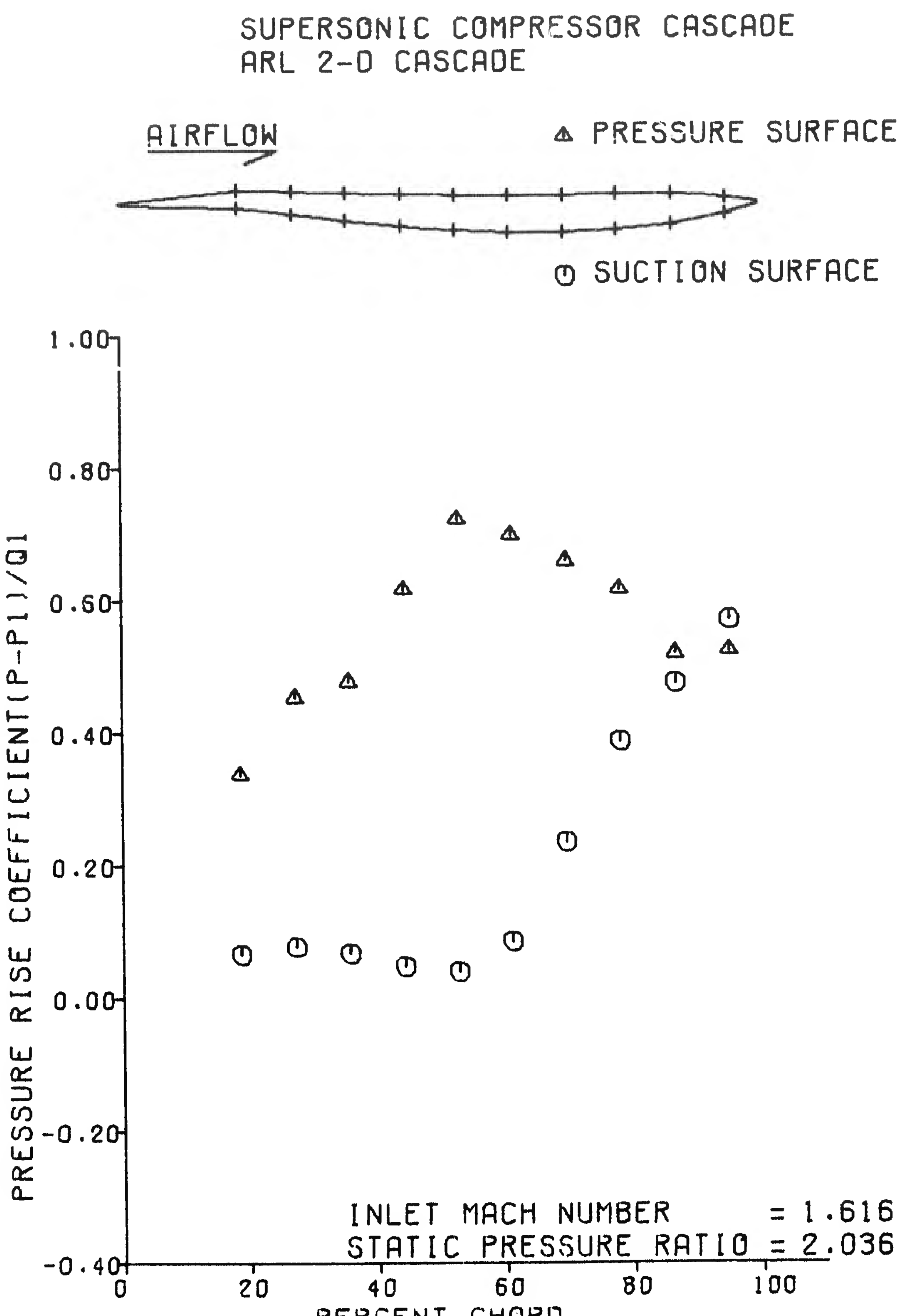
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,Y	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/D1	DEV	TURN
BETA)C	A)2/A)1						
2.036	.919	.715	.731	.708	1.622	1.258	[illegible]
.019	.365	1.641	.245	1.103	.567	1.485	[illegible]
62.195	.843						

OVERALL PERFORMANCE

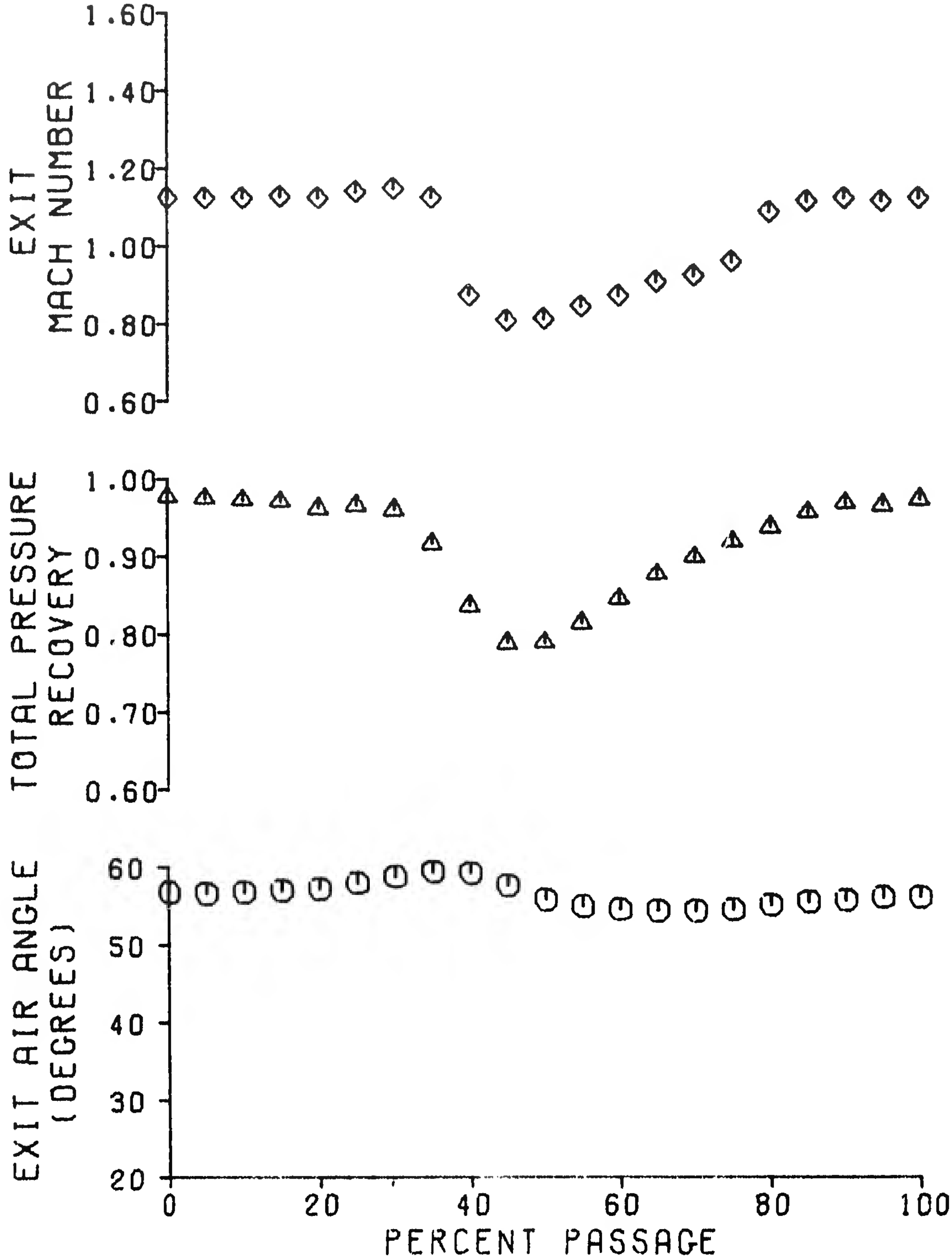
MIXED EXIT CONDITIONS

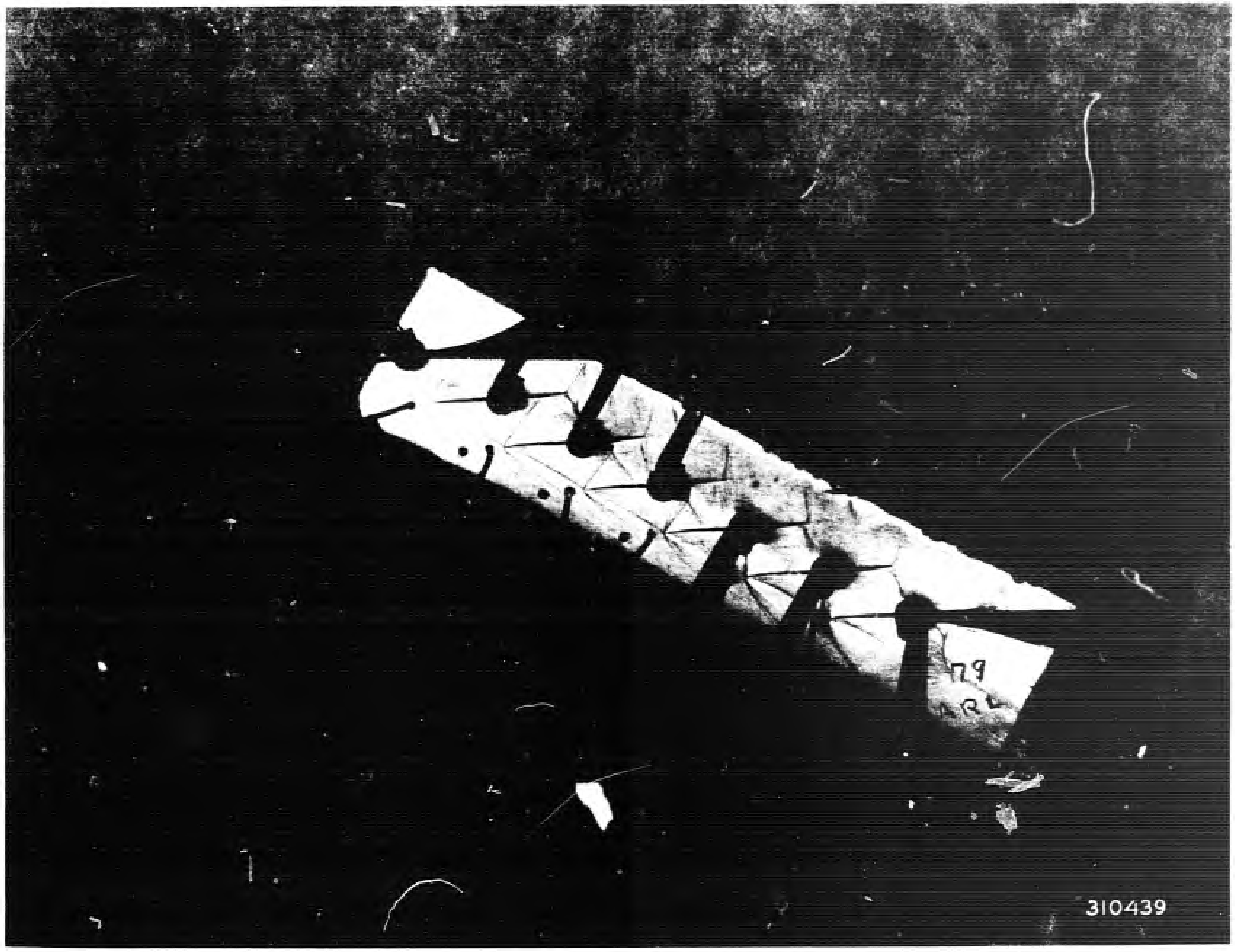
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/D1	DEV	TURN
BETA)C	A)2/A)1						
2.047	.912	.709	.716	.706	1.625	1.263	[illegible]
.020	.372	1.655	.247	1.092	.573	1.975	[illegible]
61.998	.860						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
PRESSURE RISE COEFFICIENT(P-P1)/Q1
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.616
STATIC PRESSURE RATIO = 2.036

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.616
CASCADE STATIC PRESSURE RATIO = 2.036





CASCADE SCHLIEREN

MN)1 = 1.616, P)2/P)1 = 2.036

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

DATA SET NO. 23

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.615	2.230	3	.600

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	10.573	10.559	10.563	-10.572
11	17.754	4.721	7.744	4.772
13	10.537	4.802	8.430	4.862
15	11.192	4.633	7.882	4.797
17	10.701	4.705	9.031	4.632
19	10.917	4.809	9.899	4.667
21	10.487	10.539	9.742	5.356
23	9.379	5.058	9.452	6.733
25	9.463	5.037	9.157	7.812
27	9.512	4.354	8.418	8.168
29	9.589	4.573	8.588	8.713
31	9.611	4.372	10.547	10.569
33	8.909	4.363	9.554	3.765
35	9.334	6.693	9.666	8.048
37	9.588	6.795	9.832	9.479
39	9.643	5.012	10.119	4.798
41	9.897	5.004	4.363	4.826
43	4.637	1.338	3.794	4.750
45	10.534	1.357	2.890	1.330
47	10.567	10.566	10.560	10.578

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.500	1.500	31.000	29.340	576.597

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN10	PT10	TT10	W10	BETA10
1.500	10.542	576.597	8.279	60.660

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.058	1.499
WEDGE	25	5.037	1.502
BLADE	27	4.354	1.581
BLADE	29	4.573	1.568
BLADE	31	4.372	1.598
BLADE	33	4.363	1.520
BLADE	35	6.693	1.302
BLADE	37	6.795	1.289

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.522	+3.412	39.247	1.515	1.222	.944

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
55.934	2.733	1.787	.025	1.092	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
52.947	53.797	52.832	54.923

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.513	18.542	576.507	57.258	4.264	.314	7.789

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
3.453	5.218	.874	1.359	1.822	4.349	1.124

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFOR
BASED ON SIDEWALL STA

PRESSURE DATA FROM

SCANIVALVE PORT #	SCANIVALVE NO. 3		ALVE
23	9.379		.989
25	9.463		9.334
27	9.512	37	9.588
29	9.589	39	9.643
31	9.611	41	9.897

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
9.511	.085	9.474	.334	1.025	2.230

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	5.012	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.004	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.798	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.806	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.758	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	561.079	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.330	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.061	PSIA
SECONDARY BLEED FLOW RATE	=	.290	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.035	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	7.744	4.772	.447	.065	.418	.257	18.65	18.64
13	8.430	4.860	.535	.077	.455	.262	27.14	27.15
15	7.882	4.797	.464	.068	.425	.259	35.64	35.64
17	9.031	4.632	.612	.047	.487	.250	44.09	44.12
19	9.899	4.667	.723	.052	.534	.252	52.62	52.62
21	9.742	5.356	.703	.140	.525	.289	61.11	61.10
23	9.452	6.733	.666	.317	.510	.363	69.57	69.61
25	9.157	7.812	.628	.456	.494	.421	78.08	78.13
27	8.418	8.168	.533	.501	.454	.440	86.57	86.60
29	8.588	8.713	.555	.571	.463	.470	95.04	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.323	-.275	.169	-31.610	-.008	.323	.143	44.347

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y / DEV / PT)YP	MN)2 / TURN / P)TP	MN)X,2 / M)2 / P)BP	MN)Y,2 / DP)1,2 / P)NP	PT)2 / V)2 / P)B*	P)2 / PT)O / BETA)*	PT)2/PT)1 / PT)O / PT)1	BETA)2 / PT)O,A / TT)1
	6.100	1.115	.617	.929	18.010	8.279	.971	56.428
.00	1.505	.822	.000	.532	1174.436	18.576	18.510	18.543
	17.982	10.577	11.176	10.685	10.888	-2.582	18.543	576.941
	6.189	1.113	.618	.926	17.937	8.263	.967	56.311
4.98	1.388	.939	.019	.805	1173.025	18.577	18.491	18.534
	17.910	10.534	11.152	10.651	10.856	-2.689	18.534	575.907
	6.276	1.117	.616	.932	17.958	8.239	.968	56.538
9.96	1.615	.712	.019	.584	1175.812	18.558	18.499	18.529
	17.929	10.584	11.074	10.631	10.858	-2.472	18.529	576.252
	6.368	1.134	.616	.952	18.005	8.085	.971	57.114
15.00	2.191	.136	.019	.537	1190.135	18.568	18.525	18.546
	17.962	10.491	10.931	10.559	10.768	-1.886	18.546	576.597
	6.457	1.143	.610	.966	17.915	7.949	.966	57.725
19.98	2.802	-.475	.019	.628	1197.977	18.585	18.506	18.545
	17.863	10.416	10.713	10.443	10.666	-1.275	18.547	576.597
	6.546	1.127	.589	.960	17.477	7.919	.943	58.495
24.96	3.572	-1.245	.018	1.066	1184.139	18.586	18.521	18.553
	17.441	10.329	10.445	10.283	10.537	-.515	18.553	576.941
	6.637	1.089	.561	.933	16.710	7.938	.901	58.957
30.05	4.034	-1.707	.018	1.833	1151.956	18.605	18.504	18.554
	16.697	10.179	10.188	10.098	10.270	-.043	18.554	576.252

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OCAL CASCADE EXIT PERFORMANCE

PERCT	Y / DEV / PT)YP	MN)2 / TURN / P)TP	MN)X,2 / M)2 / P)BP	MN)Y,2 / DP)1,2 / P)NP	PT)2 / V)2 / P)B*	P)2 / PT)O / BETA)*	PT)2/PT)1 / PT)O / PT)1	BETA)2 / PT)C,A / TT)1
	6.726	.890	.466	.758	15.773	9.428	.851	58.394
35.03	3.471	-1.144	.016	2.769	973.230	18.564	18.504	18.534
	15.773	9.952	10.255	9.911	10.100	-.606	18.534	576.941
	6.815	.807	.432	.682	14.667	9.556	.791	57.672
40.01	2.747	-.420	.016	3.878	863.338	18.552	18.486	18.519
	14.667	9.803	9.998	9.739	9.881	-1.330	18.519	576.597
	6.904	.784	.436	.650	14.341	9.557	.773	55.954
44.99	1.031	1.296	.015	4.201	870.874	18.567	18.518	18.542
	14.341	9.661	10.067	9.658	9.809	-3.046	18.542	576.252
	6.993	.707	.459	.551	14.565	9.586	.788	54.833
49.97	-.098	2.417	.016	3.977	883.171	18.598	18.505	18.558
	14.565	9.627	10.201	9.667	9.925	-4.167	18.558	576.252
	7.083	.838	.490	.680	15.191	9.589	.819	54.189
55.01	-.734	3.061	.017	3.351	923.753	18.574	18.516	18.545
	15.191	9.661	10.392	9.777	10.069	-4.811	18.545	576.597
	7.172	.877	.515	.710	15.874	9.619	.856	54.012
59.99	-.911	3.238	.019	2.668	961.150	18.567	18.502	18.534
	15.874	9.773	10.603	9.941	10.251	-4.978	18.534	576.597
	7.261	.919	.535	.747	16.556	9.593	.893	54.399
64.97	-.524	2.851	.019	1.986	1000.056	18.568	18.502	18.535
	16.556	9.926	10.784	10.117	10.424	-4.681	18.535	575.907

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.01	7.351 -.289 16.923	.931 2.616 10.071	.539 .019 10.894	.759 1.619 10.276	16.923 1011.833 10.564	9.671 18.568 -4.366	.913 18.515 18.542	54.634 18.542 575.562
74.00	7.440 -.020 17.139	.961 2.347 10.202	.552 .019 11.008	.786 1.404 10.381	17.139 1038.809 10.687	9.475 18.600 -4.097	.924 18.508 18.554	54.983 18.534 576.597
79.07	7.529 .182 17.283	.961 2.145 10.306	.550 .019 11.070	.789 1.259 10.483	17.283 1039.247 10.763	9.549 18.574 -3.895	.932 18.580 18.537	55.105 18.537 575.907
85.00	7.619 .739 17.500	1.053 1.588 10.394	.594 .020 11.116	.869 1.039 10.573	17.504 1121.298 10.837	8.683 18.584 -3.339	.944 18.537 18.560	55.662 18.560 576.252
89.00	7.700 .917 17.546	1.053 1.410 10.460	.591 .019 11.146	.871 .993 10.614	17.549 1121.298 10.878	8.704 18.574 -3.160	.946 18.505 18.539	55.840 18.539 575.907
94.96	7.797 .974 17.691	1.073 1.353 10.490	.602 .019 11.186	.889 .843 10.676	17.699 1138.761 10.885	8.568 18.577 -3.103	.955 18.485 18.531	55.897 18.531 576.941
100.00	7.887 1.305 17.904	1.107 1.022 10.540	.615 .020 11.177	.920 .615 10.693	17.928 1167.852 10.905	8.322 18.580 -2.772	.967 18.502 18.541	56.228 18.541 575.562

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
.996	56.113	.998

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.555	.827	16.843	8.940	576.597	1.153	1.159

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.544	.823	16.715	8.967	576.596	1.195	.987	56.566

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

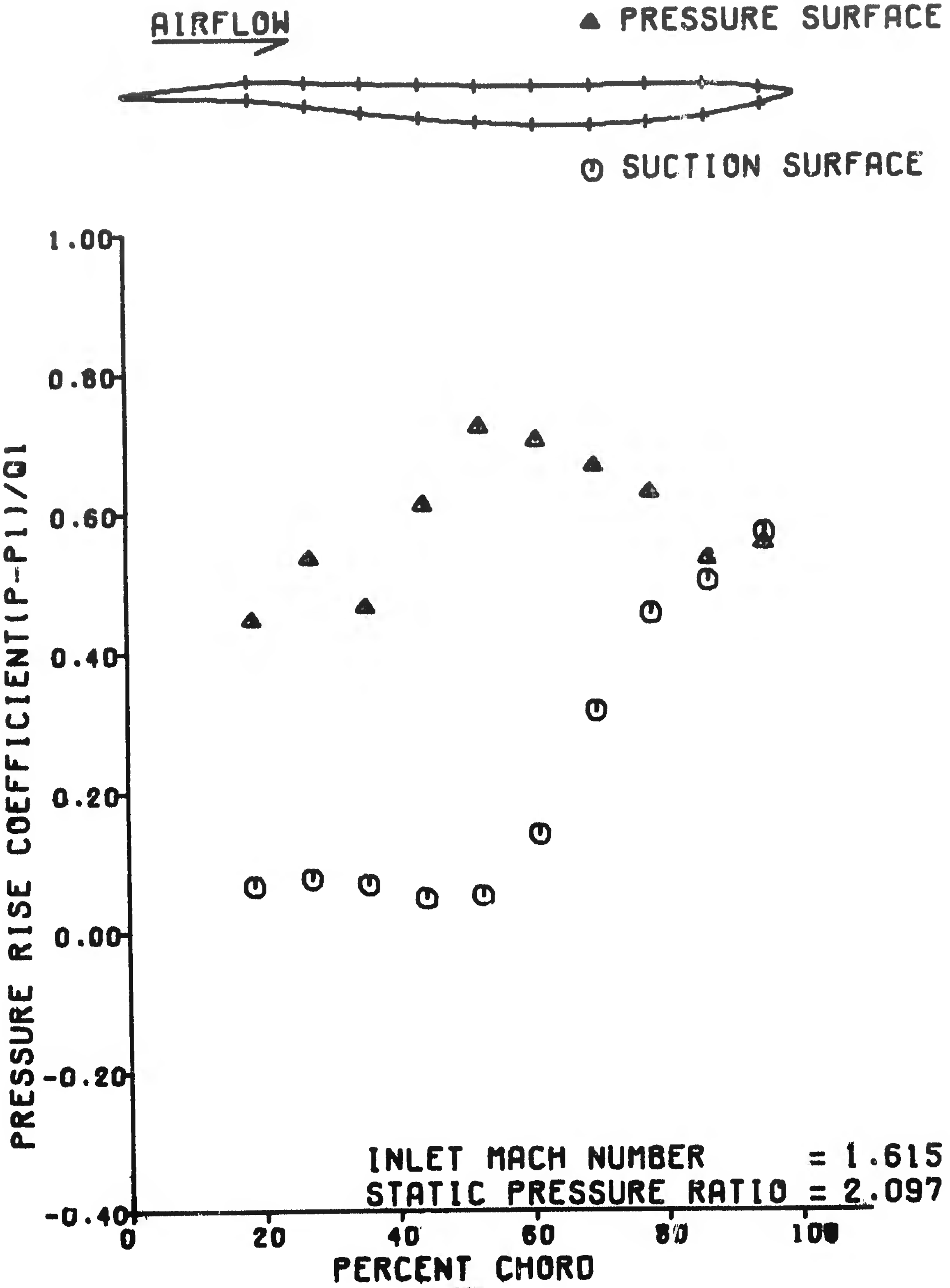
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.097	.908	.695	.716	.686	1.651	1.270	.119
.022	.392	1.694	.264	1.077	.600	1.190	1.137
61.860	.846						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

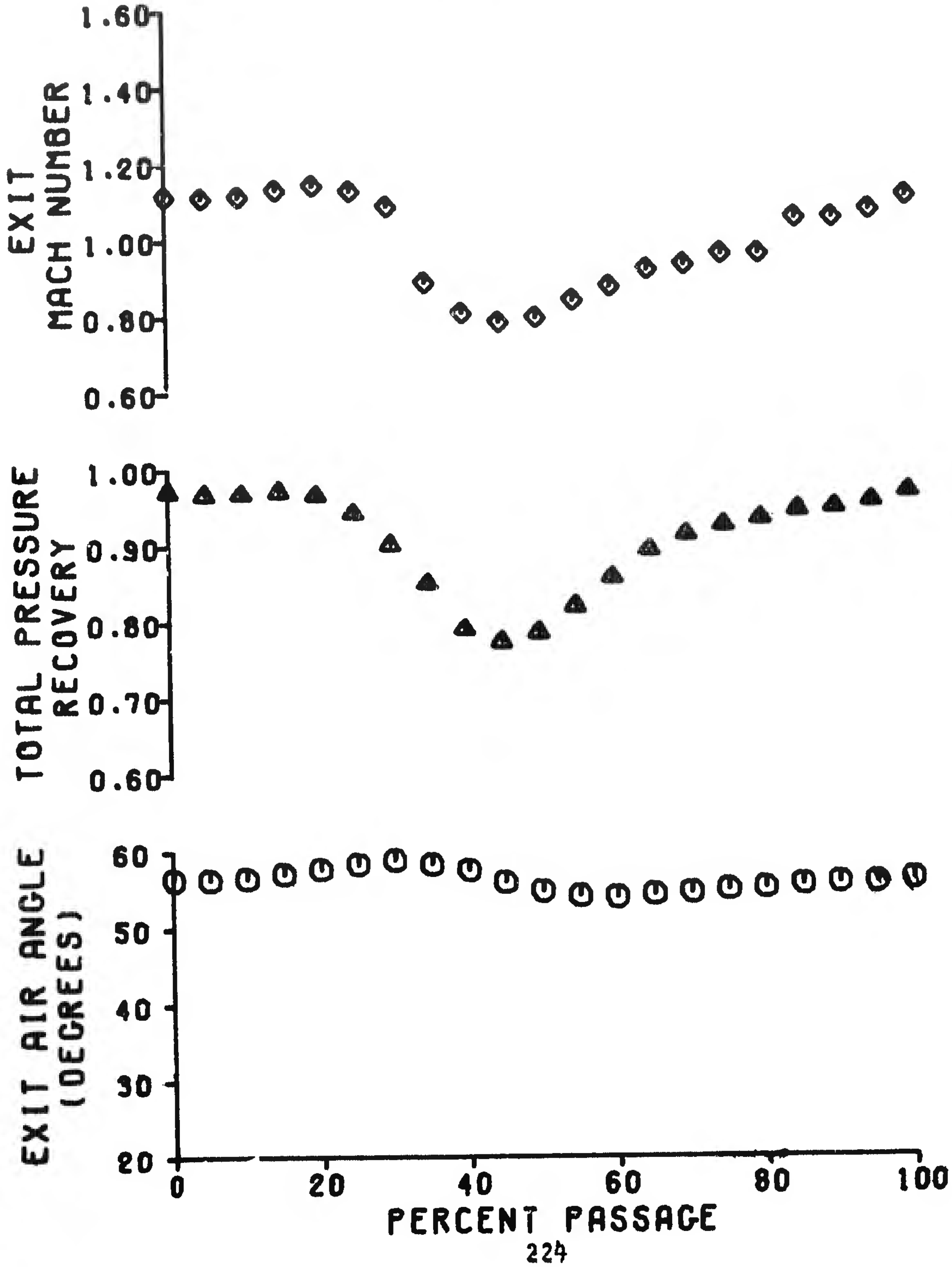
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.103	.901	.689	.702	.684	1.651	1.274	.128
.023	.397	1.708	.266	1.067	.604	1.643	.684
61.621	.863						

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE



SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.615
CASCADE STATIC PRESSURE RATIO = 2.097



CASCADE SCHLIEREN
MN)1 = 1.616. P)2/P)1 = 2.097

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE TOTAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.616	2.252	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.535	18.513	18.514	18.525
11	18.513	4.728	8.505	4.942
13	18.314	4.632	7.476	5.164
15	12.749	4.655	6.806	5.520
17	13.427	4.734	7.332	4.998
19	13.543	4.638	9.748	6.967
21	18.485	18.516	10.005	8.491
23	9.572	5.255	9.667	8.916
25	9.626	5.273	9.343	8.245
27	9.674	6.454	8.729	7.879
29	9.737	6.191	8.992	7.657
31	9.757	6.327	18.517	18.526
33	9.415	6.155	9.538	3.456
35	9.559	7.257	9.621	8.998
37	9.715	7.817	9.852	9.932
39	9.595	4.997	10.022	4.869
41	9.656	5.292	4.337	5.132
43	4.904	1.445	3.748	4.975
45	18.504	1.448	2.925	1.437
47	18.524	18.531	18.526	18.528

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.892	1.501	30.900	29.316	573.148

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN1D	PT1D	TT1D	M1D	BETA1D
1.500	18.515	573.148	8.291	58.884

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.255	1.498
WEDGE	25	5.273	1.496
BLADE	27	6.454	1.325
BLADE	29	6.191	1.356
BLADE	31	6.327	1.340
BLADE	33	6.155	1.360
BLADE	35	7.257	1.239
BLADE	37	7.217	1.264

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	-3.429	38.237	1.616	1.000	.844

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
56.934	2.733	1.797	.025	1.030	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE MI (DEGREES)	EXIT METAL ANGLE ML (DEG.)
5[illegible].947	53.727	52.032	54.923

CASCADE INLET CONDITIONS

MN1	PT1	TT1	BETA1	P1	M1	Q1
1.615	18.515	573.148	57.250	4.255	.315	7.776

IISS	IIML	MN1X,1	MN1Y,1	TT/T1	PT/P1	RE/10**6
3.453	5.218	.974	1.359	1.322	4.351	1.138

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.572	33	9.415
25	9.626	35	9.555
27	9.674	37	9.715
29	9.737	39	9.595
31	9.757	41	9.656

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P2/P1)
9.673	.369	9.533	.122	1.229	2.273

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	4.997	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.002	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.869	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	5.132	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.975	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	557.976	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.437	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.987	PSIA
SECONDARY BLEED FLOW RATE	=	.356	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.243	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.505	4.942	.546	.288	.459	.267	15.65	18.64
13	7.475	5.164	.414	.117	.424	.279	27.14	27.15
15	6.866	5.528	.342	.163	.372	.298	35.64	35.64
17	7.332	4.998	.306	.264	.306	.278	44.29	44.12
19	9.748	6.987	.726	.349	.526	.376	52.62	52.62
21	10.465	8.491	.751	.545	.545	.459	61.11	61.12
23	9.557	8.916	.606	.596	.522	.482	69.57	69.81
25	9.343	8.245	.654	.513	.525	.445	78.28	78.13
27	8.729	7.275	.575	.363	.471	.382	86.57	86.82
29	8.992	7.557	.689	.437	.485	.414	95.84	95.98

FC	FCDX	FCDY	BETA1E	CD11	CL11	MC1LE	CP1LE
.226	-.191	.119	-31.882	-.095	.225	.182	44.256

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	V DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 CP)1,2 P)KP	PT)2 V)2 P)SP	P)2 PT)C BETA)P	PT)2/PT)1 PT)C PT)1	BETA)2 PT)C,A TT)1
	6.188	.884	.487	.738	15.361	9.843	.884	56.578
.28	1.655	.672	.382	2.153	964.655	18.537	18.487	18.512
	16.361	12.233	12.554	12.335	12.443	-2.422	18.512	572.459
	6.180	.801	.454	.741	16.472	9.833	.882	56.304
4.98	1.381	.346	.216	2.743	971.446	18.544	18.461	18.582
	16.472	12.231	12.726	12.562	12.452	-2.695	18.582	572.883
	6.278	.926	.503	.754	16.678	9.792	.908	56.383
9.96	1.380	.947	.216	1.844	965.380	18.584	18.471	18.488
	15.472	12.244	12.733	12.396	12.474	-2.697	18.488	572.883
	6.368	.924	.512	.771	15.827	9.687	.905	56.491
15.28	1.568	.759	.218	1.687	1302.473	18.514	18.464	18.491
	16.827	12.287	12.735	12.415	12.492	-2.589	18.491	572.459
	6.457	.939	.560	.779	16.962	9.788	.916	56.894
19.98	1.671	.366	.218	1.552	1308.272	18.534	18.455	18.405
	16.562	12.373	12.704	12.431	12.529	-2.116	18.425	572.459
	6.546	1.353	.566	.888	17.252	8.459	.921	57.494
24.96	2.561	-.234	.218	1.462	1117.942	18.524	18.487	18.526
	17.042	12.322	12.544	12.436	12.491	-1.525	18.526	572.883
	6.637	1.148	.572	.886	17.146	[illegible]	.924	56.372
32.25	3.379	-1.352	.218	1.365	[illegible]	[illegible]	18.421	18.491
	17.135	12.325	[illegible]	12.426	12.244	-1.568	18.491	[illegible]

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	V DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)HP	MN)Y,2 CP)1,2 P)KP	PT)2 V)2 P)SP	P)2 PT)C BETA)P	PT)2/PT)1 PT)C PT)1	BETA)2 PT)C,A TT)1
	6.726	1.108	.565	.954	17.238	7.807	.922	59.373
35.21	4.450	-2.123	.317	1.476	1165.424	18.524	18.473	18.499
	17.215	12.382	12.223	12.326	12.313	.763	18.499	572.114
	6.815	.897	.441	.776	16.214	9.542	.864	[illegible]
40.21	5.477	-3.152	.215	2.512	972.654	18.543	18.494	18.518
	16.224	12.255	12.216	12.168	13.298	1.390	18.518	572.883
	6.044	.767	.391	.550	14.415	9.769	.777	[illegible]
44.99	4.372	-2.245	.215	4.900	851.287	18.542	18.484	18.511
	14.415	12.073	11.236	9.068	9.875	.285	18.511	572.114
	6.003	.714	.401	.591	13.883	9.812	.746	55.712
49.97	.789	1.438	.214	4.711	759.084	18.549	18.454	18.501
	13.883	9.576	12.252	-.567	9.836	-3.258	18.501	573.148
	7.083	.702	.468	.641	14.759	9.782	.799	54.247
55.21	-.576	2.263	.216	3.714	576.396	18.528	18.477	18.502
	14.759	9.742	12.471	9.092	17.215	-4.063	18.502	573.148
	7.172	.411	.524	.744	15.321	9.525	.880	54.887
59.99	-.936	2.363	.217	2.214	956.802	18.525	18.456	18.512
	15.321	9.844	10.578	12.773	12.268	-4.103	18.512	573.148
	7.241	1.280	.583	.507	15.019	8.232	.914	56.349
64.97	1.426	[illegible]	.219	[illegible]	[illegible]	18.533	18.495	18.514
	15.906	[illegible]	10.536	[illegible]	[illegible]	[illegible]	18.514	[illegible]

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y / DEV / PT)YP	MN)2 / TURN / P)TP	MN)X,2 / M)2 / P)8P	MN)Y,2 / DP)1,2 / P)NP	PT)2 / V)2 / F)SP	P)2 / PT)0 / BETA)P	PT)2/PT)1 / PT)0 / PT)1	BETA)2 / PT)0,A / TT)1
70.91	7.351	.926	.510	.773	16.668	9.578	.900	56.572
	1.640	.678	.018	1.846	1004.008	18.523	18.475	18.499
	16.668	10.150	10.600	10.257	10.467	-2.428	18.499	572.803
74.99	7.440	.805	.491	.740	16.493	9.801	.891	56.757
	1.834	.493	.018	2.021	975.360	18.506	18.446	18.476
	16.493	10.208	10.606	12.283	10.473	-2.243	18.476	572.803
79.07	7.529	.894	.480	.748	16.480	9.806	.890	56.818
	1.887	.440	.018	2.034	974.299	18.519	18.476	18.497
	16.480	10.246	10.634	10.324	10.491	-2.190	18.497	571.769
85.00	7.619	.892	.488	.746	16.502	9.846	.891	56.805
	1.882	.445	.018	2.012	971.868	18.545	18.482	18.514
	16.502	12.280	10.660	10.355	10.513	-2.195	18.514	573.148
89.98	7.708	.891	.489	.745	16.513	9.861	.892	56.753
	1.830	.497	.018	2.001	971.173	18.552	18.481	18.515
	16.513	10.291	10.689	10.374	10.510	-2.247	18.516	572.114
94.96	7.797	.894	.492	.746	16.568	9.862	.895	56.570
	1.647	.680	.018	1.946	973.947	18.522	18.461	18.491
	16.568	10.280	10.724	10.396	10.517	-2.440	18.491	572.114
100.00	7.887	.895	.495	.746	16.629	9.882	.898	56.472
	1.540	.778	.018	1.885	975.360	18.525	18.479	18.502
	16.629	10.309	10.762	10.425	10.538	-2.528	18.502	573.493

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
.922	56.802	.884

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAG D CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.504	.772	16.355	9.445	573.148	1.170	1.105

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2	BETA)2
.496	.770	16.291	9.465	573.148	1.168	.916	57.219

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

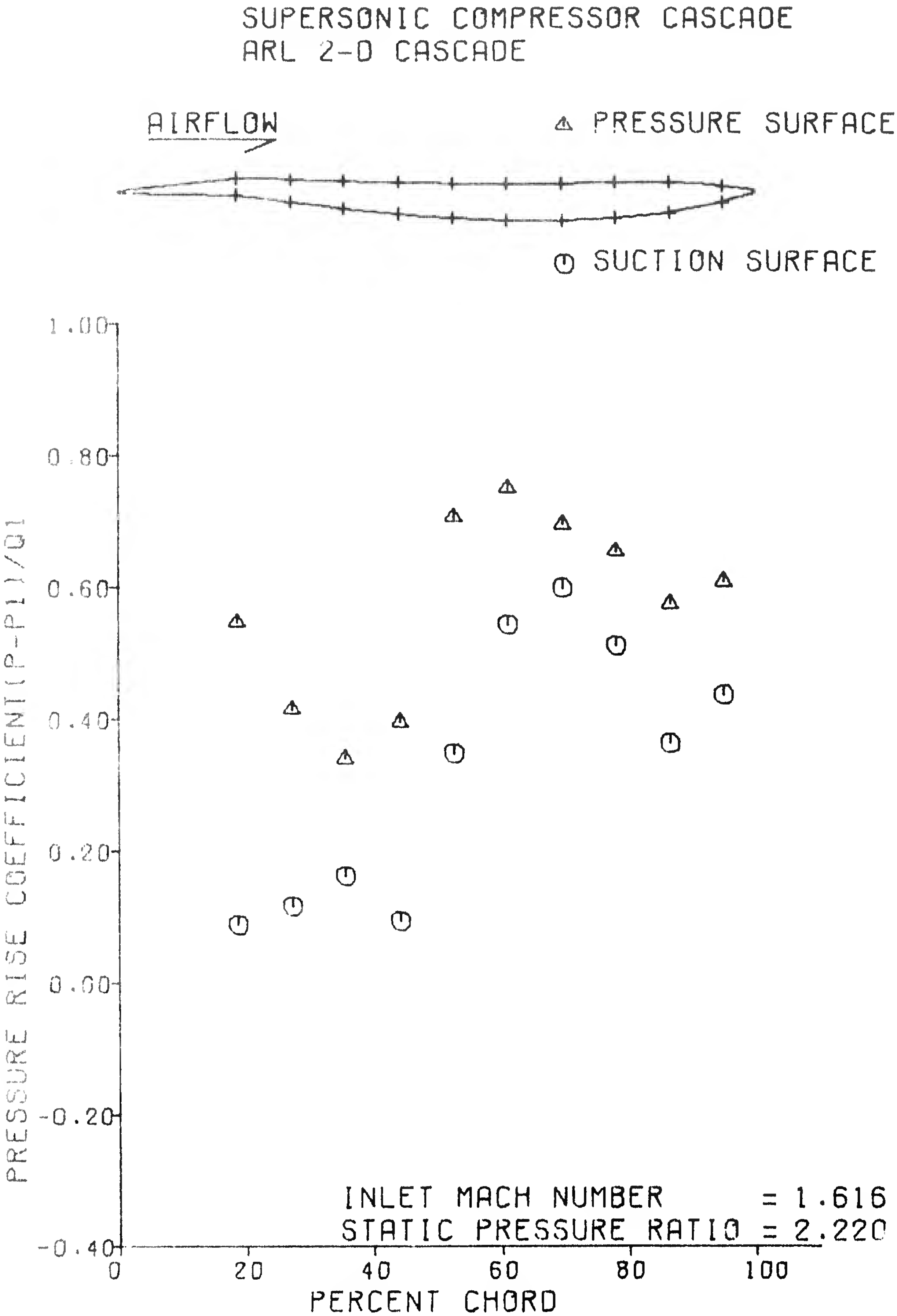
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	FN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.220	.884	.651	.657	.648	1.706	1.301	.151
.027	.446	1.819	.296	1.030	.667	1.969	.358
60.847	.692						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

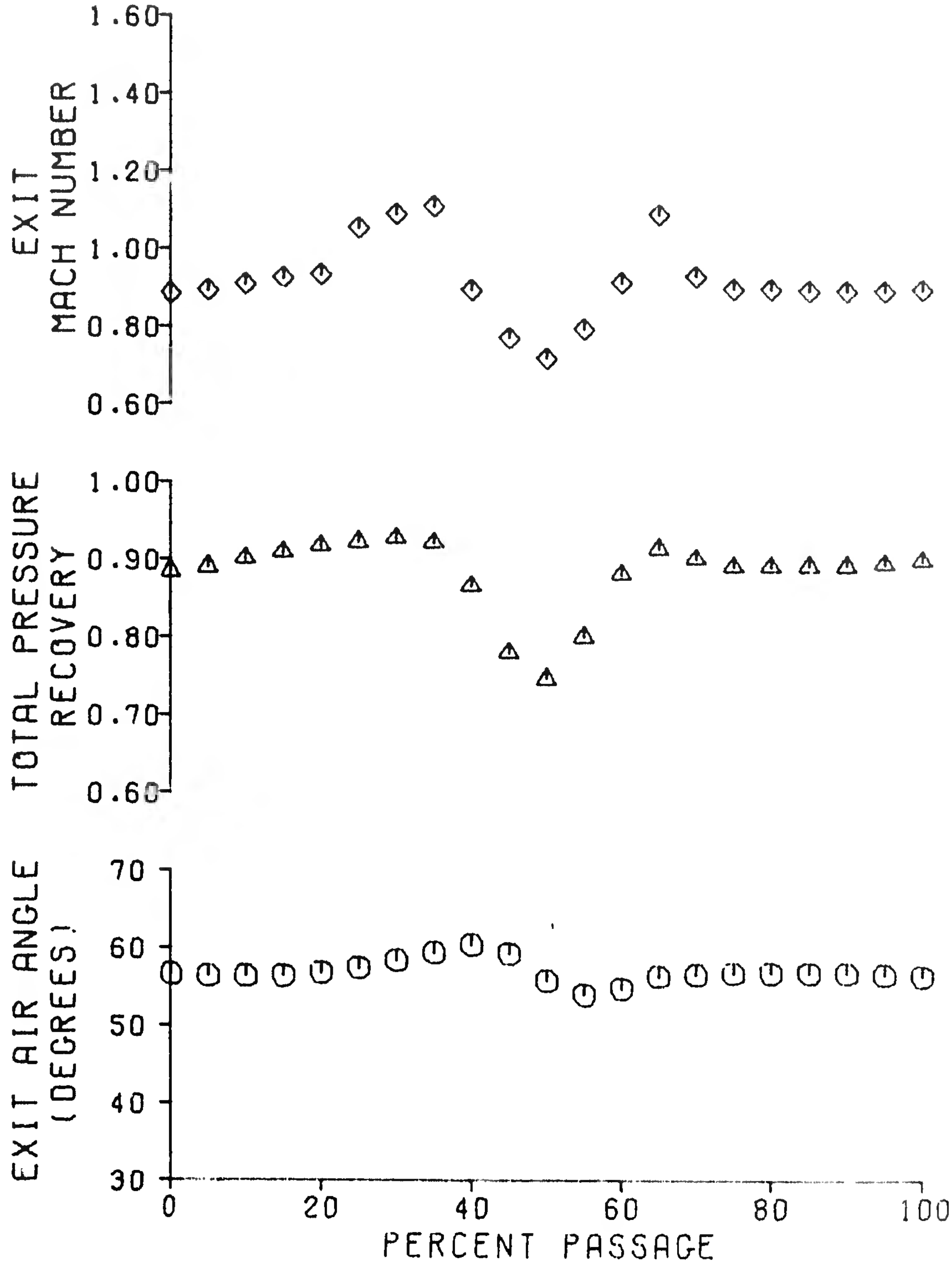
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	FN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.224	.880	.647	.648	.647	1.706	1.303	.156
.028	.450	1.829	.297	1.023	.670	2.296	.031
60.674	.905						

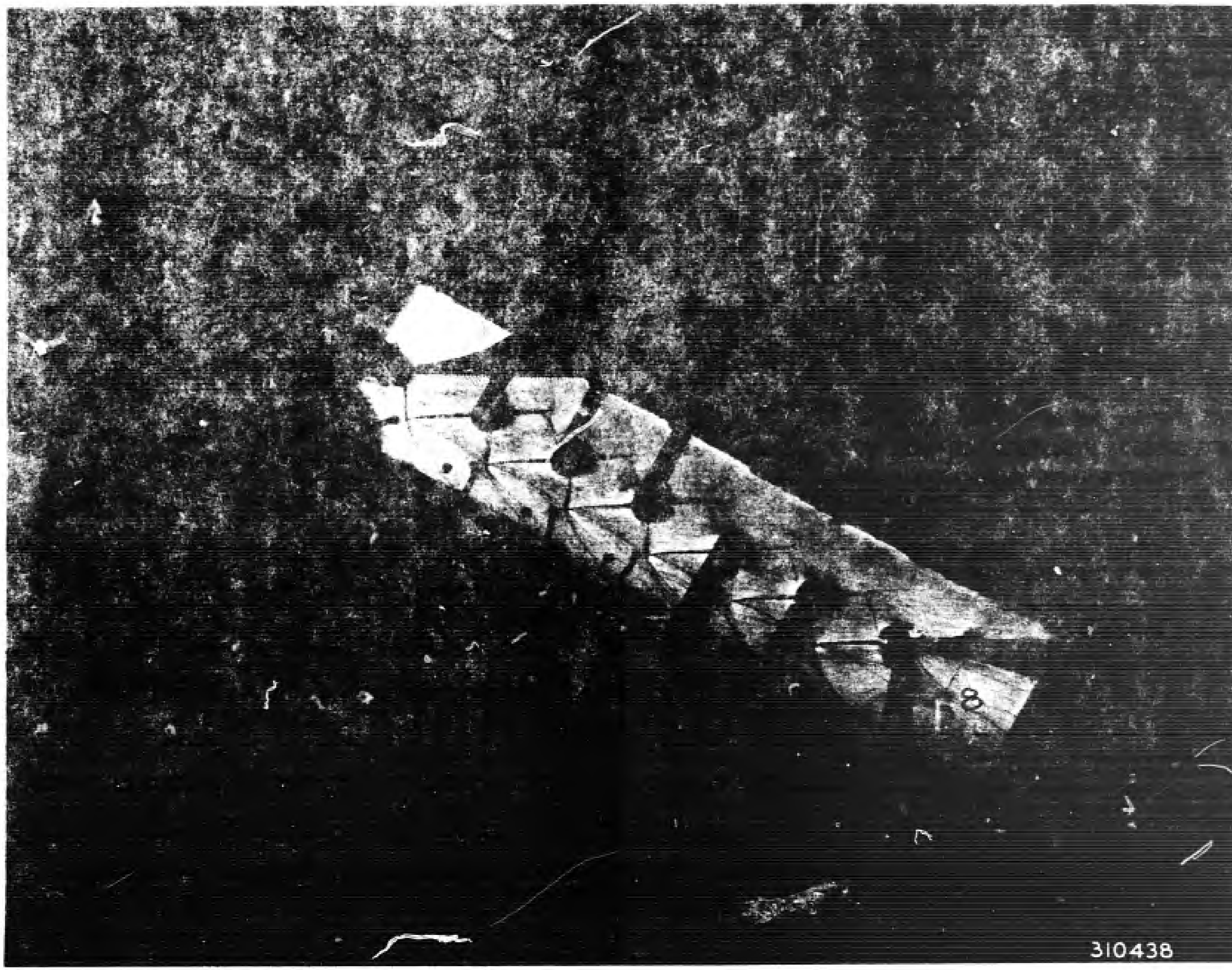


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
PRESSURE RISE COEFFICIENT((P-P1)/Q1)
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.616
STATIC PRESSURE RATIO = 2.220

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.616
CASCADE STATIC PRESSURE RATIO = 2.220





CASCADE SCHLIEREN

MN)1 = 1.616, P)2/P)1 = 2.220

SUPERSONIC COMPRESSOR CASCA
APL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.616	2.315	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.520	18.538	18.550	18.553
11	15.736	4.723	8.397	4.994
13	12.419	4.838	7.408	5.315
15	10.852	4.904	7.158	5.646
17	13.519	4.742	7.609	5.815
19	10.643	4.853	10.004	7.959
21	18.510	18.532	10.009	8.803
23	9.730	5.857	9.758	8.968
25	9.783	5.077	9.593	8.157
27	9.851	6.482	8.984	7.046
29	9.801	6.323	9.249	8.358
31	9.808	6.700	10.540	10.556
33	9.522	6.717	9.675	3.463
35	9.708	7.480	9.786	9.036
37	9.867	7.003	9.994	10.867
39	9.715	4.909	10.169	5.884
41	9.770	5.005	4.358	5.262
43	5.074	1.458	3.802	5.282
45	18.512	1.456	2.929	1.448
47	18.516	18.526	18.545	18.548

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.892	1.501	30.990	29.315	573.148

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN10	PT10	TT10	M10	BETA10
1.500	18.518	573.148	8.293	60.685

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.857	1.498
WEDGE	25	5.077	1.496
BLADE	27	6.482	1.322
BLADE	29	6.323	1.340
BLADE	31	6.700	1.298
BLADE	33	6.717	1.296
BLADE	35	7.480	1.216
BLADE	37	7.003	1.265

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	-3.420	38.237	1.616	1.000	.844

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
56.934	2.733	1.787	.825	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
50.947	53.797	52.032	54.923

CASCADE INLET CONDITIONS

MN11	PT11	TT11	BETA11	P11	M11	Q11
1.616	18.518	573.148	57.250	4.256	.315	7.778

I)SS	I)ML	MN)Y,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
3.453	5.218	.874	1.359	1.522	4.351	1.131

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.730	33	9.522
25	9.743	35	9.708
27	9.861	37	9.867
29	9.891	39	9.716
31	9.808	41	9.770

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
9.833	.066	9.717	.113	.996	318

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	4.999	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	5.005	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	5.204	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	5.262	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	5.282	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	557.976	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.448	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.087	PSIA
SECONDARY BLEED FLOW RATE	=	.358	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.043	

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.397	4.994	.532	.095	.453	.270	18.55	18.64
13	7.408	5.315	.405	.136	.400	.287	27.14	27.15
15	7.158	5.646	.373	.179	.387	.305	35.64	35.64
17	7.609	5.015	.431	.097	.411	.271	44.09	44.12
19	10.094	7.959	.751	.476	.545	.430	52.62	52.62
21	10.099	8.803	.751	.585	.545	.475	61.11	61.10
23	9.758	8.968	.707	.606	.527	.484	69.57	69.61
25	9.503	8.157	.674	.501	.513	.440	78.08	78.13
27	8.984	7.046	.608	.359	.485	.380	86.57	86.60
29	9.249	8.358	.642	.527	.499	.451	95.04	95.06

FC	FC)X	FC)Y	BETA)E	CD)1	C)1	MC)LE	CP)LE
.216	-.184	.114	-31.825	-.085	.216	.896	44.460

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN E)TP	MN)X,2 M)2 P)RP	MN)Y,2 CP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	6.102 1.675 16.471	.876 .652 10.352	.482 .000 10.769	.731 2.047 10.443	16.471 957.197 10.596	9.993 18.553 -2.402	.889 18.504 18.529	56.598 18.529 573.838
4.98	6.180 1.331 16.507	.870 .996 10.322	.488 .018 10.801	.731 2.012 10.457	16.507 969.282 10.581	9.979 18.531 -2.756	.891 18.473 18.502	56.254 18.502 572.803
9.96	6.275 1.540 16.728	.895 .787 10.355	.495 .018 10.815	.746 1.790 10.483	16.728 975.360 10.608	9.941 18.533 -2.537	.903 18.490 18.516	56.463 18.516 574.183
15.03	6.368 1.549 16.903	.936 .678 10.406	.499 .018 10.852	.756 1.619 10.522	16.903 985.380 10.621	9.927 18.563 -2.428	.913 18.510 18.541	56.572 18.541 572.803
19.98	6.457 1.067 17.028	.918 .360 10.430	.502 .018 10.826	.769 1.400 10.544	17.028 996.094 10.645	9.867 18.564 -2.110	.920 18.507 18.535	56.803 18.535 574.183
24.96	6.546 2.514 17.086	.928 -.187 10.433	.500 .018 10.733	.782 1.433 10.531	17.086 1005.965 10.622	9.705 18.551 -1.573	.923 18.468 18.510	57.437 18.510 572.114
30.05	6.637 3.424 17.156	1.053 -1.307 10.444	.553 .018 10.582	.806 1.359 10.486	17.159 1117.940 10.535	8.512 18.550 -.853	.927 18.479 18.515	58.347 18.515 573.493

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN E)TP	MN)X,2 M)2 P)RP	MN)Y,2 CP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
35.03	6.726 4.435 17.005	1.053 -2.108 10.412	.537 .017 10.339	.906 1.510 10.420	17.008 1117.940 10.436	8.437 18.553 .348	.918 18.512 18.532	59.358 18.532 573.145
40.01	6.815 5.314 15.928	.863 -2.987 10.363	.429 .016 10.160	.749 2.502 10.256	15.928 945.000 10.197	9.705 18.546 1.227	.860 18.511 18.528	60.237 18.528 573.493
44.00	6.924 4.258 14.260	.735 -1.931 10.197	.376 .014 10.175	.631 4.258 10.007	14.260 819.205 10.009	9.960 18.541 .181	.770 18.502 18.521	59.181 18.521 572.114
49.07	6.993 .749 13.722	.694 1.578 9.987	.391 .014 10.349	.573 4.706 9.982	13.722 777.525 9.974	9.948 18.545 -3.329	.741 18.457 18.501	55.672 18.501 572.803
55.01	7.083 -.002 14.754	.771 3.220 9.918	.453 .015 10.584	.624 3.764 10.029	14.754 855.358 10.176	9.958 18.536 -4.970	.797 18.489 18.513	54.821 18.513 572.803
59.90	7.172 -.275 16.107	.577 2.602 9.957	.508 .017 10.694	.716 2.411 10.158	15.107 958.542 10.356	9.757 18.542 -4.352	.870 18.515 18.529	54.648 18.529 571.769
64.97	7.261 .808 16.825	.027 1.429 10.120	.521 .018 10.715	.767 1.713 10.292	16.805 1004.564 10.521	9.650 18.555 -3.189	.907 18.522 18.538	55.821 18.538 572.803

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	MN12 TURN PITP	MN1X,2 M12 P1BP	MN1Y,2 CP11,2 PINP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,4 TT11
70.01	7.351 1.522 16.684	.898 .805 10.238	.501 .819 10.702	.755 1.834 10.348	16.684 985.380 10.572	9.801 18.545 -2.555	.901 18.484 18.515	56.445 18.515 573.149
74.99	7.449 1.747 16.502	.891 .580 10.318	.492 .818 10.732	.745 1.926 10.399	16.592 971.682 10.682	9.993 18.547 -2.332	.898 18.482 18.514	56.679 18.514 572.459
79.97	7.520 1.986 16.620	.885 .421 10.363	.484 .818 10.748	.742 1.900 10.431	16.600 965.298 10.625	9.985 18.557 -2.181	.897 18.504 18.538	56.800 18.538 573.148
85.00	7.610 1.744 16.629	.885 .583 10.386	.486 .814 10.801	.730 1.807 10.473	16.620 965.290 10.638	9.996 18.558 -2.343	.898 18.497 18.527	56.667 18.527 573.148
89.98	7.728 1.800 16.658	.885 .437 10.482	.484 .818 10.780	.747 1.861 10.476	16.658 965.290 10.632	10.014 18.554 -2.197	.900 18.479 18.516	56.813 18.516 573.148
94.96	7.797 1.779 16.662	.885 .516 10.399	.487 .818 10.421	.739 1.857 10.524	16.662 965.209 10.645	10.016 18.542 -2.378	.900 18.491 18.516	56.632 18.516 571.762
100.00	7.887 1.657 16.753	.901 .570 10.420	.401 .718 10.857	.744 1.765 10.523	16.753 971.378 10.664	10.002 18.571 -2.430	.905 18.513 18.542	56.580 18.542 573.403

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN12	BETA12	PT12/PT11
.891	56.830	.895

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	M12/M11
.487	.746	16.390	9.790	573.148	1.159	1.105

MIXED EXIT CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	MN12	BETA12
.482	.744	16.313	9.787	573.148	1.157	.886	57.009

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

OVERALL PERFORMANCE

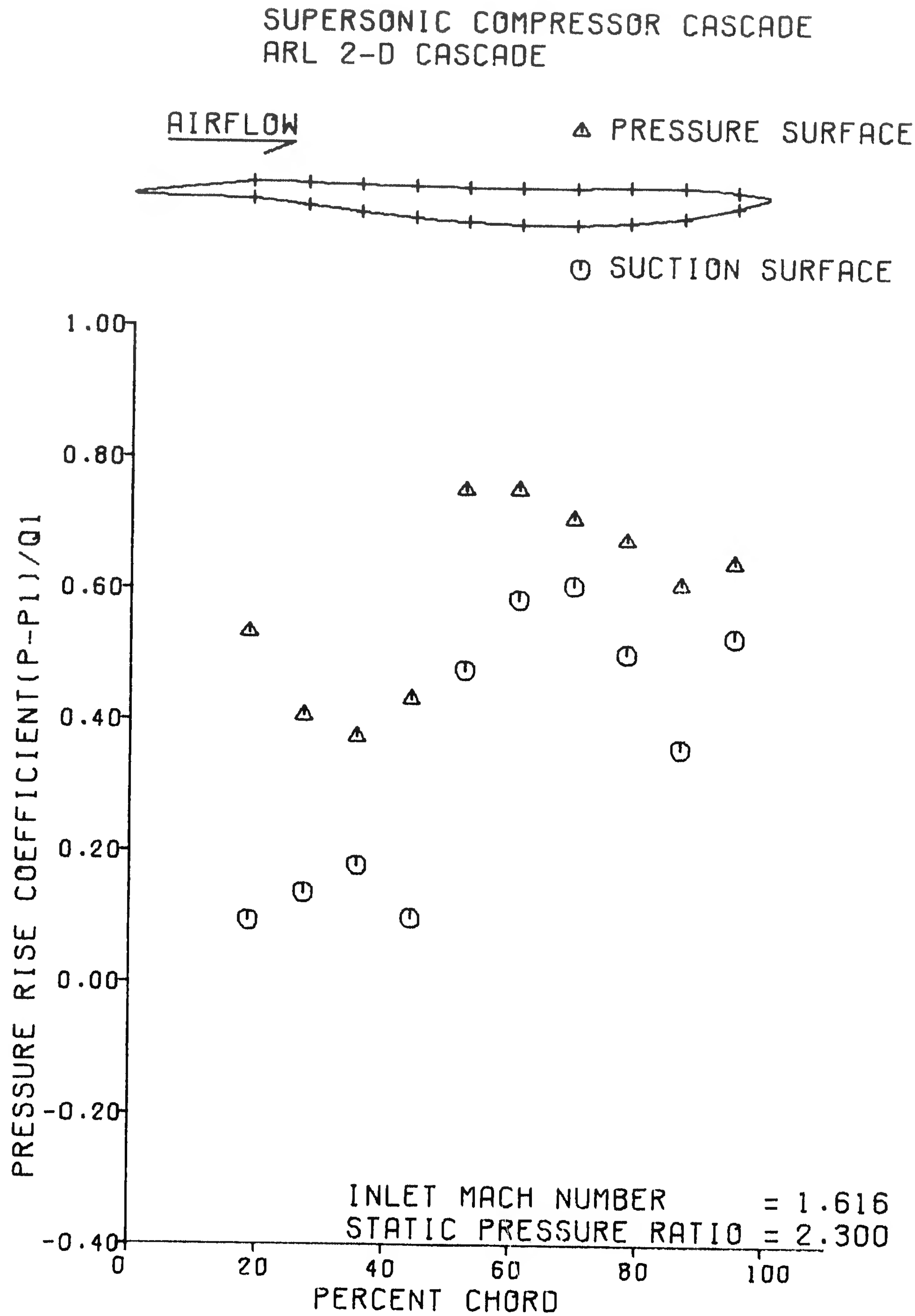
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.300	.885	.632	.639	.629	1.751	1.314	.149
.027	.470	1.879	.312	1.019	.711	1.916	.411
60.719	.894						

OVERALL PERFORMANCE

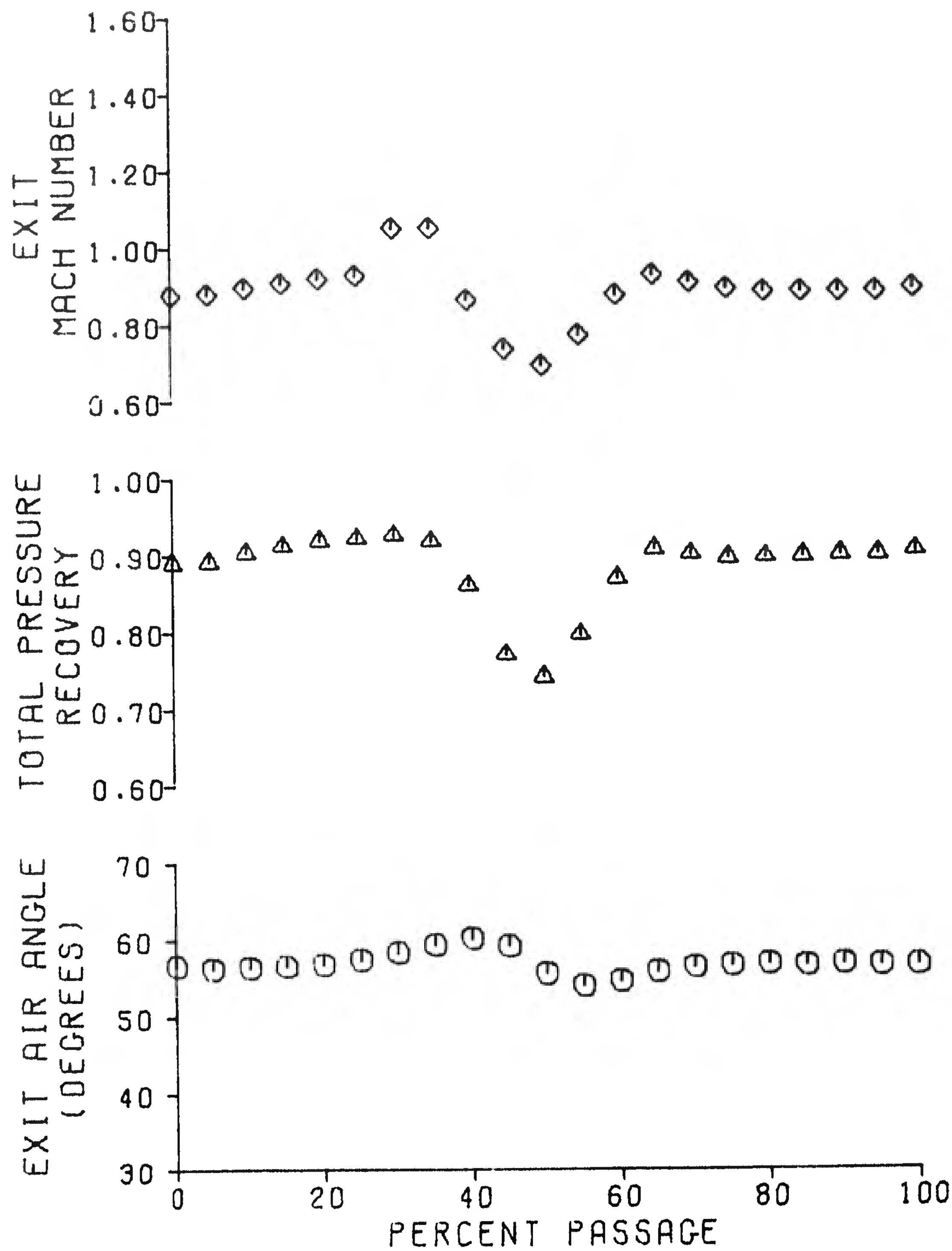
MIXED EXIT CONDITIONS

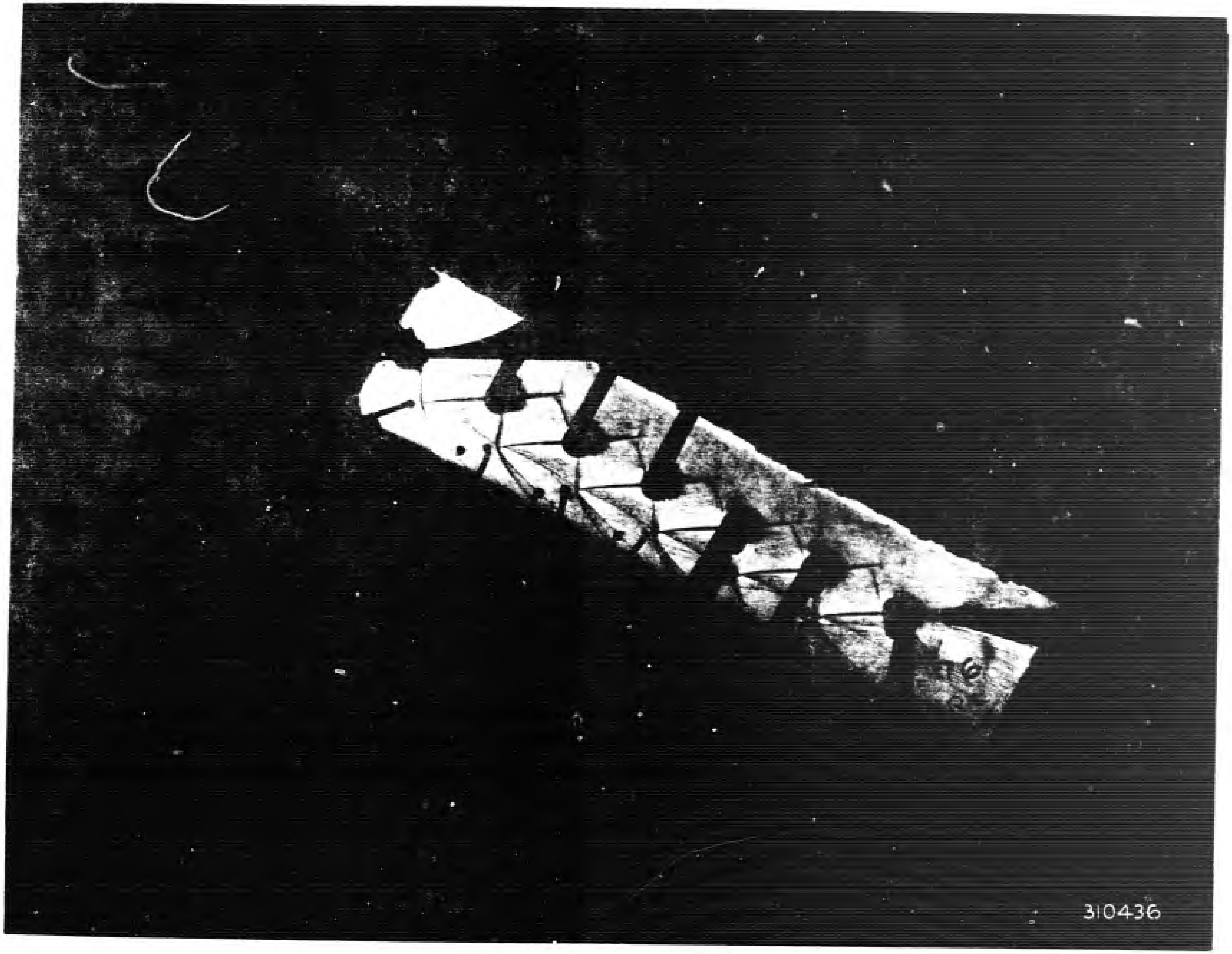
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.299	.881	.629	.632	.628	1.748	1.315	.155
.027	.473	1.887	.313	1.012	.711	2.166	.161
60.540	.905						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
PRESSURE RISE COEFFICIENT(P-P1)/Q1
INLET MACH NUMBER = 1.616
STATIC PRESSURE RATIO = 2.300
0
20
40
60
80
100
PERCENT CHORD

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.616
CASCADE STATIC PRESSURE RATIO = 2.300





CASCADE SCHLIEREN

MN)1 = 1.616, P)2/P)1 = 2.300

APPENDIX F

CASCADE PERFORMANCE DATA

MN)1 = 1.683

P)2/P)1 = 1.119

P)2/P)1 = 1.356

P)2/P)1 = 1.543

P)2/P)1 = 1.751

P)2/P)1 = 1.982

P)2/P)1 = 2.230

P)2/P)1 = 2.274

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SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.683	1.195	3	.688

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.667	18.679	18.689	18.684
11	18.431	4.772	4.892	4.831
13	5.443	4.878	4.533	4.146
15	5.352	4.618	4.215	4.163
17	5.942	4.752	4.081	3.974
19	6.571	4.866	3.972	3.988
21	18.596	18.684	3.527	3.668
23	4.565	5.248	2.976	3.584
25	4.444	5.196	3.074	3.268
27	4.567	3.858	4.145	3.176
29	4.433	3.745	5.589	4.454
31	4.680	3.894	18.675	18.682
33	4.763	3.585	4.524	2.719
35	4.744	3.661	3.945	4.917
37	4.647	4.171	5.358	4.472
39	4.562	5.232	3.924	4.812
41	4.122	8.028	4.572	4.822
43	4.616	1.333	3.947	4.688
45	18.654	1.349	3.899	1.328
47	18.657	18.650	18.665	18.682

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.885	1.524	31.888	25.997	578.399

246

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MNIC	PT1C	TT1C	M1C	BETA1C
1.488	18.642	578.398	8.368	64.883

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.248	1.478
WEDGE	25	5.196	1.484
BLADE	27	3.858	1.687
BLADE	29	3.745	1.705
BLADE	31	3.894	1.688
BLADE	33	3.585	1.734
BLADE	35	3.661	1.721
BLADE	37	4.171	1.634

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.488	-5.752	36.459	1.683	1.884	.758

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
58.934	2.723	1.787	.025	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
[illegible]0.947	53.797	52.032	54.923

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.883	18.640	578.390	58.250	3.875	.295	7.682

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/(P**6
4.453	6.218	.886	1.431	1.566	4.818	1.118

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	4.565	33	4.763
25	4.444	35	4.744
27	4.567	37	4.647
29	4.933	39	4.562
31	4.689	41	4.122

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
4.639	.168	4.567	.234	1.562	1.197

SUPERSONIC COMPRESSOR CASCADE
NO. 2 WT CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE = 4.232 PSIA

SOUTH SIDEWALL BLEED PLENUM PRESSURE = 4.224 PSIA

NOZZLE EXTENSION PLENUM PRESSURE 1 = 4.812 PSIA

NOZZLE EXTENSION PLENUM PRESSURE 2 = 4.822 PSIA

NOZZLE EXTENSION PLENUM PRESSURE 3 = 4.882 PSIA

SECONDARY BLEED ORIFICE TEMPERATURE = 553.148 R

SECONDARY BLEED ORIFICE PRESSURE = 1.328 PSIA

SECONDARY BLEED ORIFICE DELTA P = .052 PSIA

SECONDARY BLEED FLOW RATE = .266 LB/SEC

RATIO OF BLEED TO NOZZLE MASS FLOW RATE = .232

SUPERSONIC COMPRESSOR CASCADE
NO. 2 WT CASCADE

PLATE WITH BLEED PARAMETERS

	PRESSURE SURFACE (PSI)	SUCTION SURFACE (PSI)	(PS/P1) (PSI)	(SS/P1) (PSI)	(PS/PT1)	(SS/PT1)	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	4.852	1.131	.132	.222	.242	.218	16.68	15.64
13	4.573	2.188	.188	.235	.245	.222	27.14	27.15
15	4.215	4.162	.244	.237	.226	.223	35.64	35.44
17	2.261	3.274	.224	.213	.218	.213	44.25	44.17
19	3.070	3.071	.212	.223	.213	.209	52.62	52.47
21	3.527	3.880	-.148	-.228	.168	.195	61.11	61.17
23	2.976	3.584	-.117	-.238	.162	.192	67.57	69.61
25	3.274	3.260	-.106	-.260	.148	.178	78.78	78.13
27	4.145	3.178	.035	-.251	.222	.172	86.57	86.62
29	5.880	4.454	.223	.275	.322	.239	95.24	95.06

FC	FC1X	FC1Y	BETA1E	CL11	CL11	MCILE	CPILE
.832	-.028	.218	-33.612	.227	.232	.215	48.145

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	MN12 TURN P1TP	MN1X,2 M12 P1RP	MN1Y,2 CP11,2 P1KP	PT12 V12 P1SP	P12 PT1D BETA1P	PT12/PT11 PT1D PT11	BETA12 PT1D,A TT11
	6.130	1.544	.847	1.291	18.588	4.752	.997	56.733
.22	1.812	1.517	.222	.252	1487.125	18.684	18.627	18.653
	17.015	6.247	6.929	6.152	7.212	-2.257	18.653	571.279
	6.190	1.514	.840	1.254	18.362	4.808	.985	55.808
4.08	.075	2.352	.217	.276	1467.942	18.596	18.622	18.659
	16.947	6.285	7.271	6.456	7.232	-3.182	18.659	572.734
	6.278	1.516	.824	1.276	18.456	4.894	.992	57.152
9.95	2.229	1.208	.217	.184	1470.585	18.682	18.612	18.647
	17.258	6.408	6.040	6.540	7.258	-1.848	18.647	572.734
DELP PROBE -.288								
	6.348	1.572	.847	1.322	18.548	4.583	1.288	57.347
15.22	2.424	.983	.217	.282	1524.288	18.667	18.622	18.644
	17.149	6.277	6.727	6.256	6.818	-1.583	18.644	571.279
DELP PROBE -.135								
	6.457	1.570	.847	1.332	18.642	4.526	1.202	57.551
19.98	2.628	.600	.216	.280	1529.731	18.672	18.621	18.648
	16.954	6.173	6.569	6.166	6.603	-1.450	18.646	572.734
DELP PROBE -.172								
	6.545	1.623	.844	1.363	18.642	4.366	1.222	58.232
24.96	3.390	.714	.216	.201	1525.211	18.658	18.614	18.636
	16.817	6.101	6.291	6.126	6.459	-.778	18.636	572.734
	6.637	1.611	.827	1.382	18.583	4.365	.997	58.247
32.75	3.124	.203	.216	.257	1523.914	18.667	18.615	18.651
	16.628	6.126	6.272	5.914	6.415	-.051	18.651	571.279

249

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	MN12 TURN P1TP	MN1X,2 M12 P1RP	MN1Y,2 CP11,2 P1KP	PT12 V12 P1SP	P12 PT1D BETA1P	PT12/PT11 PT1D PT11	BETA12 PT1D,A TT11
	6.726	1.522	.841	1.387	18.495	4.212	.992	58.761
35.83	3.838	-.511	.215	.145	1537.034	18.674	18.637	18.655
	16.463	5.923	5.983	5.679	6.388	-.239	18.655	571.279
	6.815	1.653	.849	1.418	18.685	4.247	.998	59.188
42.21	4.177	-.852	.215	.035	1555.925	18.698	18.620	18.659
	16.278	5.758	5.733	5.562	6.279	.188	18.659	572.734
	6.934	1.676	.839	1.451	18.383	3.850	.986	59.948
44.09	5.025	-1.408	.214	.257	1572.177	18.682	18.617	18.653
	15.909	5.617	5.386	5.381	5.795	.938	18.657	571.279
	6.993	1.537	.764	1.334	14.927	3.854	.801	62.196
49.07	5.273	-1.946	.213	3.713	1482.740	18.660	18.575	18.622
	13.898	5.494	5.246	5.185	5.487	1.196	18.622	571.279
	7.283	1.429	.725	1.232	13.815	3.865	.867	59.537
55.31	4.614	-1.287	.212	5.628	1429.688	18.676	18.623	18.658
	12.182	5.328	5.234	5.270	5.328	.527	18.657	572.734
	7.172	1.458	.764	1.242	13.614	3.940	.732	58.387
60.04	3.464	-.137	.212	5.028	1420.726	18.681	18.617	18.649
	12.832	5.250	5.375	5.563	5.336	-.611	18.649	571.424
	7.261	1.540	.560	1.285	15.637	4.370	.852	56.523
64.07	1.855	1.727	.713	2.802	1484.409	18.677	18.626	18.651
	14.517	5.186	6.126	5.652	5.486	-2.477	18.651	572.114

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERC	Y DEV PT1,P	MN12 TURN P1TP	MN1X,2 M12 P1RP	MN1Y,2 DP11,2 P1NP	PT12 V12 F1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,A TT11
	7.351	1.582	.939	1.274	17.273	4.171	.927	53.624
70.31	-1.209	4.626	.916	1.367	1512.174	18.680	18.680	18.645
	15.574	5.390	6.656	5.458	5.851	-5.376	18.645	571.879
	7.449	1.560	.994	1.278	19.086	4.513	.978	55.038
74.99	.137	3.229	.917	.554	1497.969	18.686	18.593	18.639
	16.457	5.793	6.782	5.927	6.673	-3.970	18.639	570.734
FELD PROBE -.636								
	7.529	1.632	.909	1.355	18.640	4.183	1.000	55.135
79.97	1.212	2.115	.916	.992	1543.864	18.667	18.617	18.642
	16.906	5.619	6.565	5.662	6.469	-2.865	18.642	571.789
DELR PROBE -.160								
	7.619	1.609	.914	1.324	18.649	4.324	1.003	55.351
85.34	.464	2.863	.917	.992	1528.857	18.669	18.631	18.650
	16.747	5.710	6.634	5.850	6.454	-3.613	18.650	572.114
FELD PROBE -.62								
	7.708	1.650	.909	1.384	18.640	-.869	1.000	56.971
90.08	2.048	1.279	.916	.900	1554.486	18.661	18.603	18.632
	16.804	5.704	6.231	5.723	6.259	-2.039	18.632	570.734
	7.787	1.567	.958	1.249	18.265	4.512	.982	52.315
[illegible]	-2.647	5.435	.917	.375	1502.328	18.348	18.611	18.649
	16.572	5.555	7.224	5.847	6.523	-5.648	18.649	571.769
	7.887	1.555	.973	1.267	18.122	4.093	.972	54.527
100.00	1.396	3.723	.918	.518	1494.797	18.672	18.616	18.644
	16.5[illegible]	5.831	5.944	5.964	6.629	-4.473	18.644	571.879

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN12	BETA12	PT12/PT11
1.575	56.907	.953

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	M12/M11
.862	1.319	17.755	4.335	573.390	1.495	1.046

MIXED EXIT CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	MN12	BETA12
.847	1.315	17.525	4.345	572.390	1.492	1.554	57.294

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

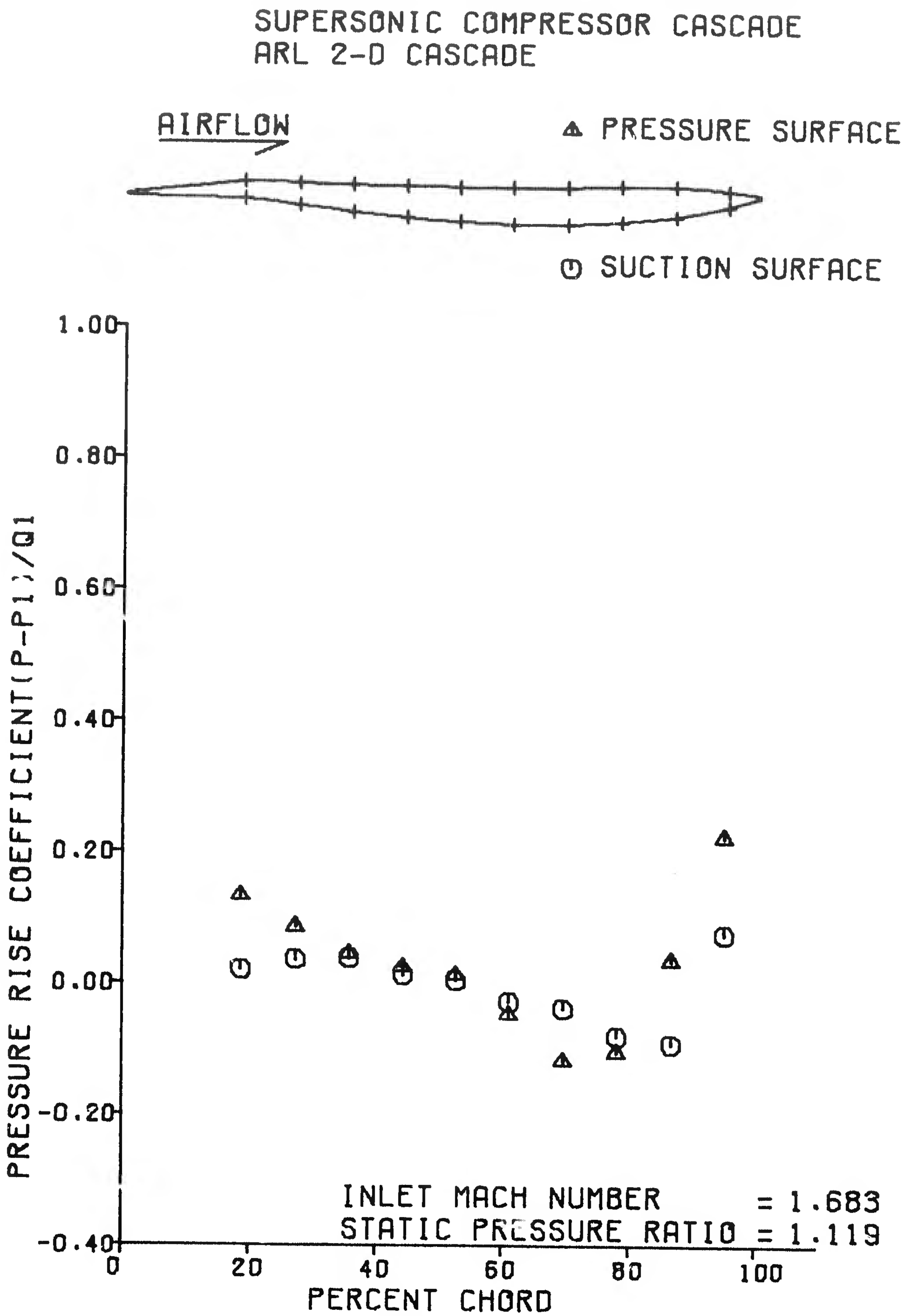
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.119	.953	.958	.994	.943	1.068	1.047	.060
.011	.056	1.180	.048	1.105	.060	1.984	1.343
59.049	.942						

OVERALL PERFORMANCE

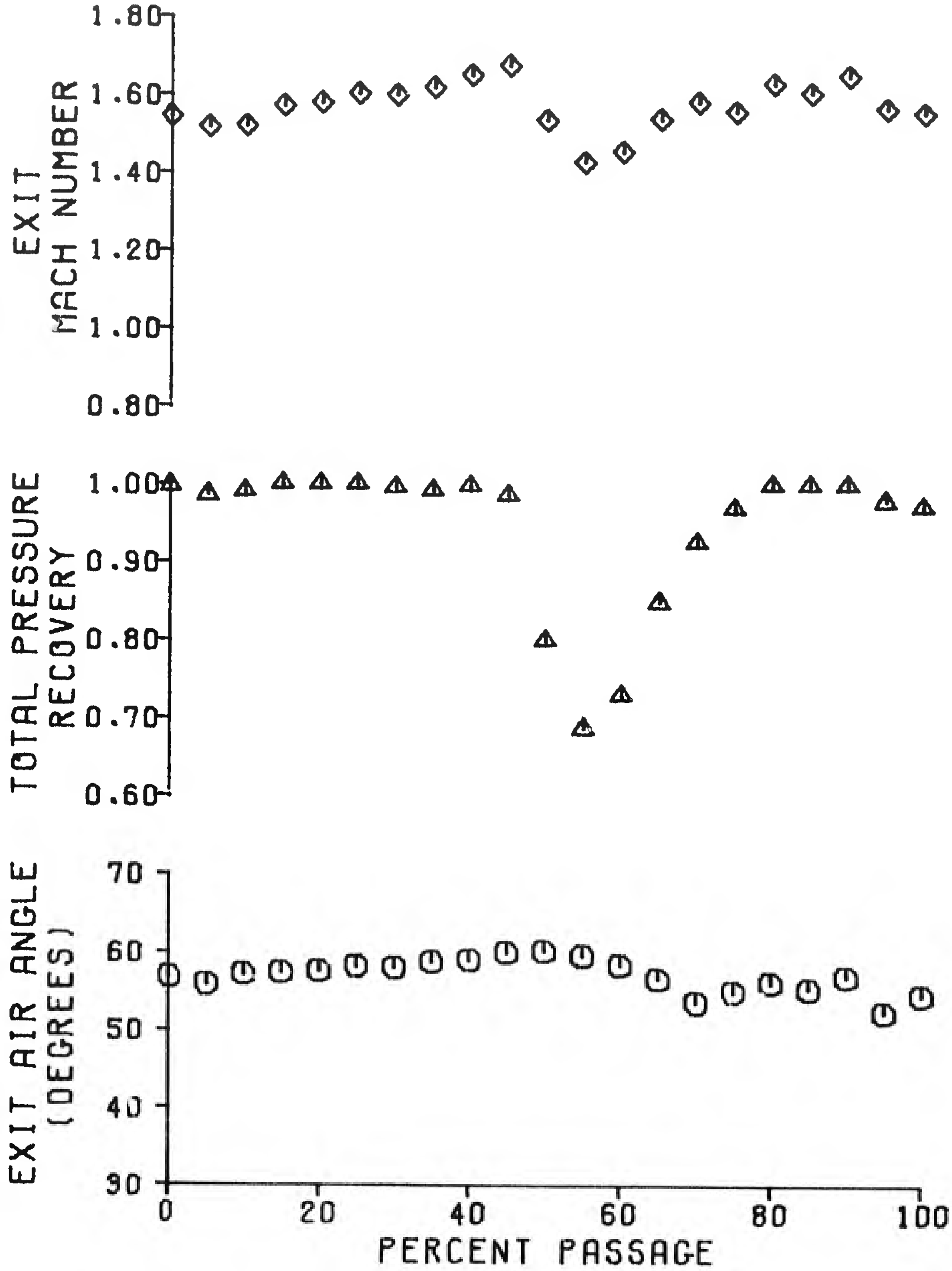
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.121	.940	.953	.981	.942	1.066	1.252	.075
.013	.063	1.186	.049	1.094	.061	2.281	1.046
58.823	.956						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
PRESSURE RISE COEFFICIENT(P-P1)/Q1
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.683
STATIC PRESSURE RATIO = 1.119

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.683
CASCADE STATIC PRESSURE RATIO = 1.119



CASCADE SCHLIEREN

MN)1 = 1.683, P)2/P)1 = 1.119

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.683	1.369	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.393	18.388	18.372	18.384
11	17.525	4.612	5.050	4.179
13	7.731	4.788	4.625	4.314
15	7.862	4.544	4.278	4.313
17	7.871	4.597	4.114	4.167
19	7.930	4.787	3.964	4.004
21	18.322	18.370	3.473	3.829
23	5.013	5.188	3.018	3.772
25	5.033	5.069	3.359	3.365
27	5.227	3.808	3.767	3.578
29	5.438	3.798	5.533	4.793
31	5.392	4.010	18.365	18.404
33	4.851	3.700	5.356	2.040
35	5.093	3.708	5.357	4.308
37	5.359	4.271	5.514	5.730
39	5.049	4.963	5.927	4.709
41	5.755	4.963	4.486	4.727
43	4.549	1.374	3.945	4.589
45	18.363	1.372	3.033	1.347
47	18.366	18.394	18.390	18.391

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.892	1.501	30.990	26.977	571.079

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

PN1D	PT1D	TT1D	M1D	BETA1D
1.488	18.362	571.079	8.237	83.023

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.188	1.485
WEDGE	25	5.069	1.487
BLADE	27	3.808	1.686
BLADE	29	3.798	1.687
BLADE	31	4.010	1.650
BLADE	33	3.700	1.703
BLADE	35	3.708	1.702
BLADE	37	4.271	1.608

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.498	-5.772	36.442	1.683	1.000	.749

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
56.934	2.733	1.787	.025	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	SS	ML	EXIT METAL ANGLE ML (DEG.)
60.947	53.707	52.032	54.023

CASCADE INLET CONDITIONS

MN11	PT11	TT11	BETA11	P11	M11	Q11
1.683	18.360	571.070	57.250	3.813	.299	7.565

I1SS	I1ML	MN1X.1	MN1Y.1	TT/T11	PT/P11	WR/10**6
3.453	5.218	.911	1.416	1.567	4.815	1.099

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	5.013	33	4.851
25	5.033	35	5.893
27	5.227	37	5.359
29	5.438	39	5.049
31	5.392	41	6.755

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P12/P11)
5.220	.176	5.421	.088	1.470	1.369

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	4.963	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	4.963	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.709	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.727	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.589	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	556.941	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.347	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.067	PSIA
SECONDARY BLEED FLOW RATE	=	.306	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.037	

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	5.050	4.179	.163	.048	.275	.228	18.68	18.64
13	4.625	4.314	.107	.056	.252	.235	27.14	27.15
15	4.278	4.313	.061	.066	.233	.235	35.64	35.64
17	4.114	4.167	.040	.047	.224	.227	44.09	44.12
19	3.964	4.004	.022	.025	.216	.218	52.62	52.62
21	3.473	3.829	-.045	.002	.189	.209	61.11	61.10
23	3.018	3.772	-.105	-.005	.164	.205	69.57	69.41
25	3.359	3.365	-.060	-.059	.183	.183	78.08	78.13
27	3.767	3.578	-.006	-.031	.205	.195	86.57	86.60
29	5.533	4.793	.227	.130	.301	.261	95.24	95.06

FC	FC)X	FC)Y	BETA1*	CD)1	CL)1	MC)LE	CP)LE
.014	-.011	.008	-33.761	.000	.014	.002	[illegible].371

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 CP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
	6.120	1.477	.814	1.232	18.159	5.117	.989	56.539
.00	1.616	.711	.800	.201	1443.313	18.391	18.357	18.374
	17.016	6.522	7.145	6.790	7.572	-2.471	18.374	571.079
	6.189	1.438	.796	1.197	17.701	5.271	.964	56.380
4.98	1.457	.870	.917	.659	1415.765	18.414	18.345	18.380
	16.784	6.786	7.432	6.913	7.495	-2.630	18.380	570.734
	6.278	1.481	.799	1.247	18.064	5.057	.984	57.364
9.95	2.441	-.114	.917	.296	1446.416	18.416	18.320	18.368
	16.932	6.681	7.393	6.647	7.314	-1.646	18.368	570.734
DELP PROBE -.320								
	6.368	1.538	.804	1.312	18.360	4.729	1.000	58.509
15.00	3.586	-1.259	.915	.000	1484.579	18.392	18.326	18.359
	17.114	6.575	6.704	6.426	7.013	-.501	18.359	571.079
	6.457	1.524	.752	1.325	18.320	4.820	.998	62.431
19.98	5.509	-3.181	.315	.940	1475.068	18.388	18.323	18.355
	16.892	5.932	6.571	6.423	6.776	1.421	18.355	571.424
	6.546	1.492	.688	1.324	17.911	4.937	.976	62.541
24.96	7.618	-5.291	.914	.449	1453.707	18.382	18.337	18.359
	16.609	7.328	6.444	6.469	6.879	3.531	18.359	571.424
	6.637	1.501	.687	1.335	17.884	4.862	.974	62.748
29.95	7.825	-5.498	.914	.476	1460.108	18.410	18.330	18.370
	16.621	7.184	6.247	6.364	6.968	3.748	18.370	571.079

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 CP)1,2 P)NP	PT)2 V)2 F)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
	6.726	1.516	.696	1.346	17.835	4.749	.971	62.665
35.03	7.742	-5.415	.914	.525	1460.606	18.412	18.340	18.376
	16.493	7.000	6.088	6.332	6.810	3.665	18.376	570.734
	6.815	1.496	.648	1.348	17.481	4.792	.952	64.308
40.01	9.383	-7.356	.913	.879	1456.239	18.393	18.344	18.368
	16.278	7.262	5.962	6.430	6.657	5.306	18.368	571.079
	6.904	1.495	.632	1.355	17.334	4.756	.944	65.011
44.99	10.088	-7.761	.913	1.026	1455.830	18.403	18.325	18.364
	16.144	7.263	5.804	6.435	6.587	6.001	18.364	570.045
	6.993	1.363	.571	1.238	14.736	4.874	.803	65.243
49.97	10.320	-7.003	.912	3.624	1363.578	18.389	18.317	18.349
	14.247	7.238	5.955	6.312	6.496	6.233	18.349	570.390
	7.083	1.192	.507	1.079	12.254	5.107	.667	64.844
55.01	9.921	-7.594	.911	6.106	1232.098	18.399	18.342	18.371
	12.175	7.313	6.353	6.719	6.472	5.844	18.371	571.079
	7.172	1.230	.579	1.085	13.139	5.208	.716	61.911
59.99	6.088	-4.661	.911	5.221	1262.544	18.382	18.341	18.362
	13.002	7.235	6.720	6.746	6.615	2.901	18.362	571.424
	7.261	1.366	.714	1.165	15.835	5.217	.862	58.499
64.97	3.576	-1.249	.913	2.525	1365.654	18.430	18.342	18.386
	15.300	7.079	7.191	6.746	6.919	-.511	18.386	571.079

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y / DEV / PT1YP	MN12 / TURN / P1TP	MN1X,2 / M12 / P1RP	MN1Y,2 / DP11,2 / P1NP	PT12 / V12 / F1SP	P12 / PT1D / BETA1P	PT12/PT11 / PT1D / PT11	BETA12 / PT1D,A / TT11
	7.351	1.426	.725	1.227	17.633	5.343	.960	59.421
70.01	4.498	-2.171	.016	.727	1408.211	18.416	18.379	18.398
	16.779	7.308	7.207	6.974	7.467	.411	18.398	571.879
	7.440	1.432	.703	1.248	18.160	5.453	.990	60.595
74.99	5.672	-3.345	.015	.192	1412.901	18.398	18.333	18.365
	17.255	7.592	7.185	6.945	7.869	1.595	18.365	571.879
DELP PROBE -.101								
	7.529	1.476	.725	1.286	18.360	5.178	1.000	60.592
79.97	5.669	-3.342	.015	.002	1442.902	18.406	18.347	18.377
	17.303	7.418	7.008	6.749	7.351	1.592	18.377	571.879
	7.619	1.413	.737	1.276	17.955	5.538	.978	58.546
85.00	3.623	-1.296	.015	.405	1399.335	18.398	18.337	18.367
	17.145	7.383	7.590	7.400	7.646	-.464	18.367	572.459
DELP PROBE -.022								
	7.700	1.455	.722	1.263	18.360	5.337	1.000	60.238
89.98	5.307	-2.980	.015	.000	1420.450	18.389	18.343	18.366
	17.342	7.434	7.119	7.029	7.559	1.230	18.366	571.879
	7.797	1.380	.739	1.165	17.939	5.798	.977	57.606
94.96	2.683	-.356	.016	.421	1375.573	18.400	18.324	18.362
	17.277	7.556	7.905	7.540	8.125	-1.404	18.362	571.424
	7.807	1.385	.724	1.181	18.229	5.849	.993	58.489
100.00	3.566	-1.239	.017	.131	1379.344	18.414	18.331	18.373
	17.533	7.742	7.874	7.885	7.933	-.521	18.373	571.769

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN12	BETA12	PT12/PT11
1.430	60.399	.945

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	M12/M11
.710	1.250	17.358	5.171	571.879	1.413	.982

MIXED EXIT CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	MN12	BETA12
.693	1.244	17.193	5.196	571.879	1.406	1.424	60.071

SUPERSONIC COMPRESSOR CASCADE
APL 2-D CASCADE

OVERALL PERFORMANCE

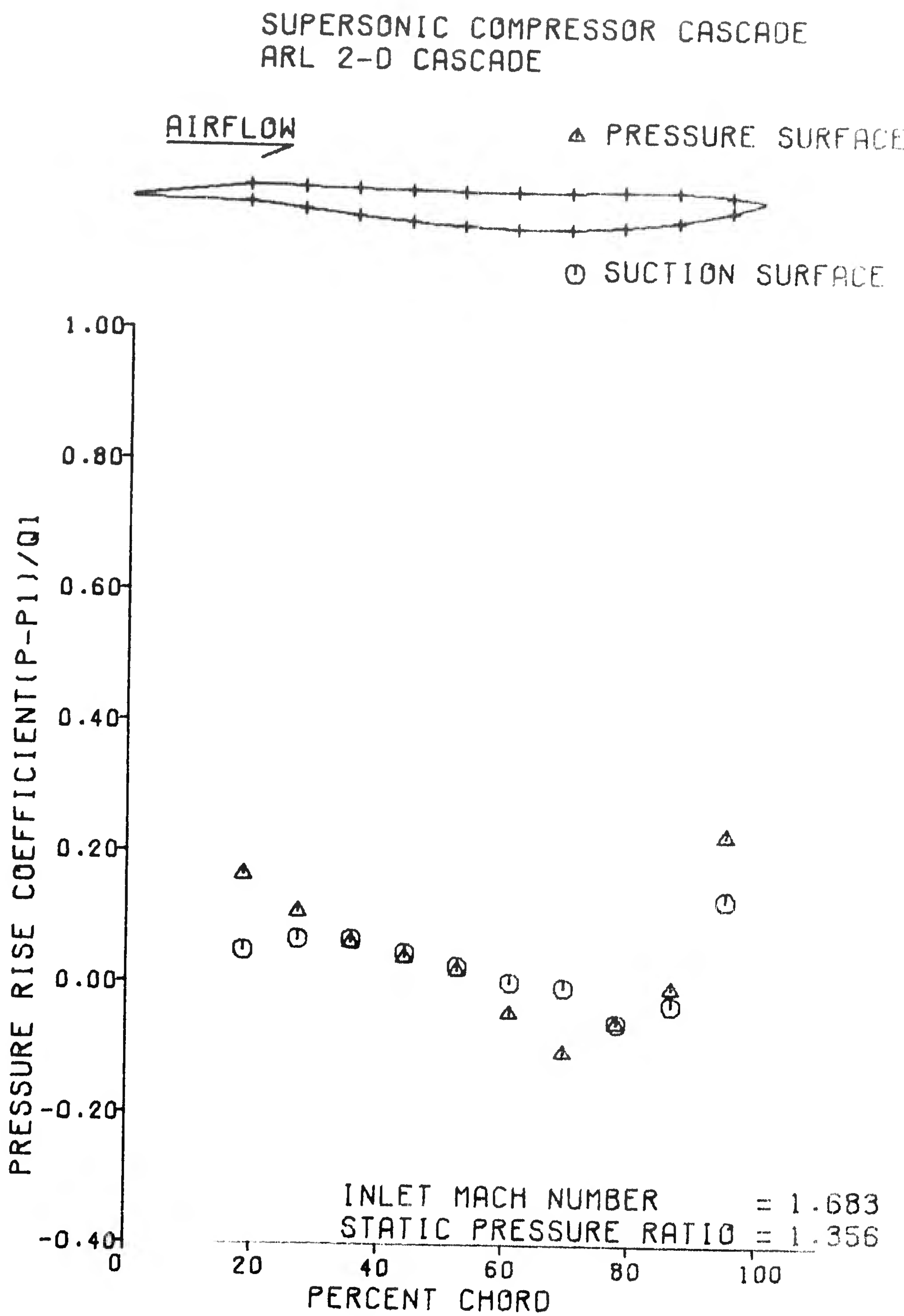
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TRIP	DF	DE)EQ	DV)Y	MN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.356	.945	.892	.821	.930	1.223	1.109	.069
.211	.120	1.260	.050	1.119	.179	5.476	-3.149
60.537	.996						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

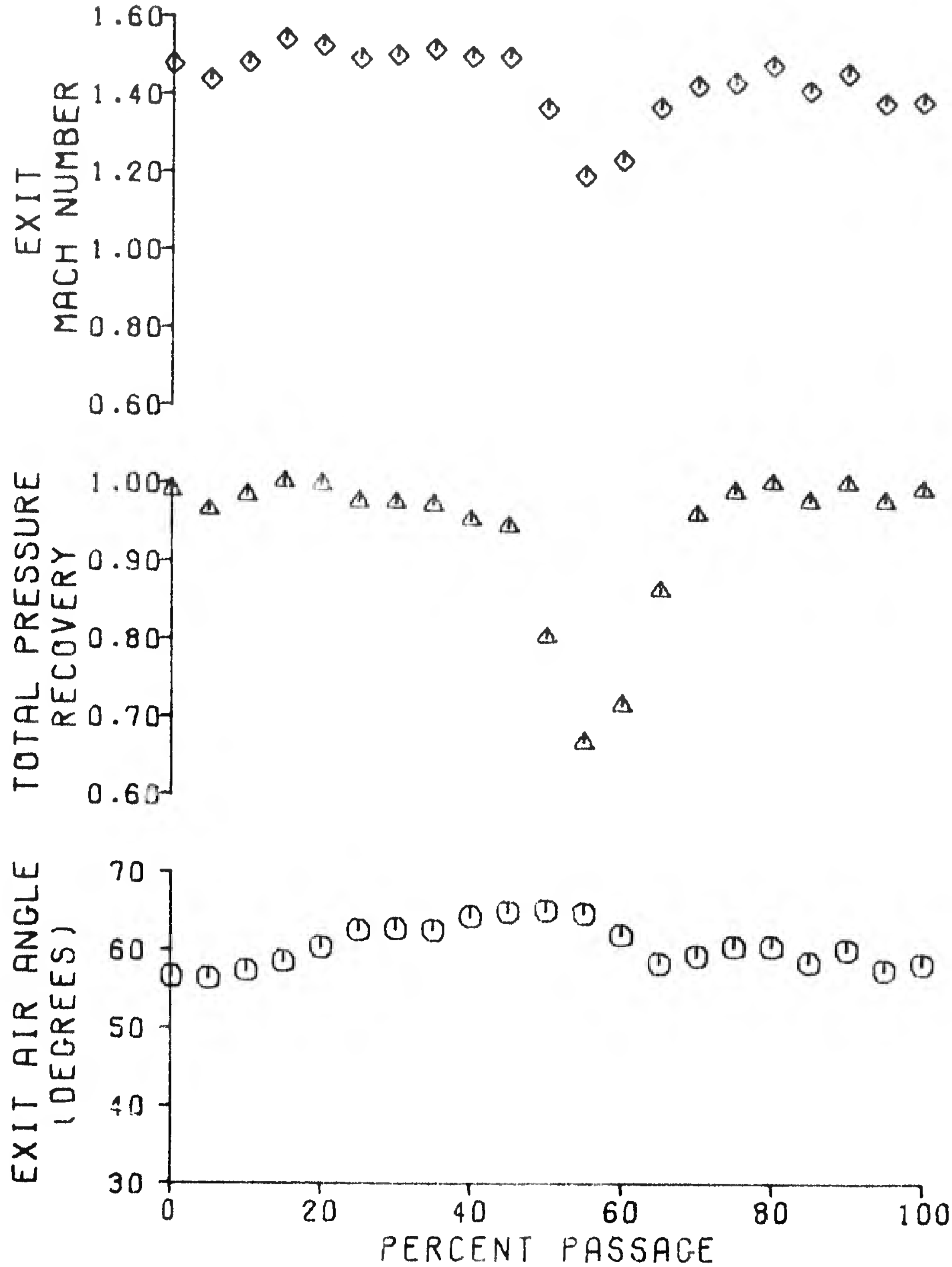
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TRIP	DF	DE)EQ	DV)Y	MN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.362	.932	.803	.804	.928	1.222	1.115	.086
.014	.127	1.269	.261	1.106	.183	5.948	-3.621
62.289	1.018						



SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
PRESSURE RISE COEFFICIENT(P-P1)/Q1
INLET MACH NUMBER = 1.683
STATIC PRESSURE RATIO = 1.356
0
20
40
60
80
100
PERCENT CHORD

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.683
CASCADE STATIC PRESSURE RATIO = 1.356



CASCADE SCHLIEREN

MN)1 = 1.683, P)2/P)1 = 1.356

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE TOTAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.683	1.530	3	.682

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.366	18.356	18.354	18.376
11	17.570	4.612	5.048	4.176
13	8.481	4.786	4.620	4.317
15	7.855	4.541	4.272	4.307
17	8.075	4.500	4.114	4.165
19	8.168	4.783	3.959	4.002
21	18.301	18.333	3.840	3.831
23	5.703	5.112	3.972	3.768
25	6.083	5.097	4.887	3.368
27	6.307	3.798	6.124	3.626
29	6.062	3.794	6.600	4.783
31	5.960	4.005	18.356	18.371
33	5.935	3.706	5.766	2.979
35	5.889	3.720	6.171	5.959
37	5.832	4.273	6.013	6.339
39	8.171	4.964	6.497	4.702
41	7.157	4.962	4.401	4.727
43	4.550	1.282	3.908	4.591
45	18.341	1.252	3.018	1.217
47	18.356	18.364	18.369	18.367

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.891	1.501	30.990	26.985	570.045

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN1C	PT1C	TT1C	M1C	BETA1C
1.488	18.341	570.045	8.236	63.015

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.112	1.484
WEDGE	25	5.097	1.486
BLADE	27	3.798	1.686
BLADE	29	3.794	1.686
BLADE	31	4.005	1.658
BLADE	33	3.706	1.702
BLADE	35	3.720	1.699
BLADE	37	4.273	1.607

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.488	-5.764	36.449	1.683	1.000	.752

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
58.034	2.733	1.787	.025	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	SS (DEGREES)	ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
50.947	53.797	52.232	54.923

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.583	18.341	570.045	57.250	3.811	.299	7.558

L)SS	L)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	RE/10**6
3.453	5.218	.911	1.416	1.567	4.813	1.101

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	5.703	33	5.935
25	6.000	35	5.889
27	6.307	37	5.632
29	6.062	39	6.171
31	5.860	41	7.157

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
6.[illegible]2	.206	6.197	.494	1.371	1.575

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	4.964	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	4.962	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.782	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.727	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.591	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	553.148	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.217	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.046	PSIA
SECONDARY BLEED FLOW RATE	=	.246	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.030	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	5.048	4.176	.164	.048	.275	.228	18.65	18.64
13	4.620	4.310	.107	.066	.252	.235	27.14	27.15
15	4.272	4.307	.061	.066	.233	.235	35.64	35.64
17	4.114	4.165	.040	.047	.224	.227	44.09	44.12
19	3.959	4.002	.020	.025	.216	.218	52.62	52.62
21	3.840	3.831	.004	.003	.209	.209	61.11	61.10
23	3.970	3.768	.021	-.006	.216	.205	69.57	69.61
25	4.887	3.368	.142	-.059	.266	.184	78.08	78.13
27	6.124	3.626	.306	-.025	.334	.198	86.57	86.60
29	6.690	4.763	.381	.125	.365	.261	95.04	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.082	-.069	.044	-32.873	-.000	.082	.057	69.952

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	6.100 5.948 17.495	1.404 -3.021 7.944	.683 .000 7.470	1.226 .065 7.458	18.276 1391.372 7.939	5.713 18.361 1.861	.998 18.297 18.329	60.871 18.329 570.390
4.98	6.189 5.972 17.416	1.412 -3.645 7.855	.687 .016 7.374	1.234 .109 7.386	18.233 1397.140 7.824	5.634 18.361 1.885	.994 18.298 18.330	60.895 18.330 569.355
9.96	6.278 6.392 17.244	1.425 -4.065 7.739	.684 .015 7.152	1.250 .224 7.166	18.118 1406.283 7.716	5.497 18.356 2.315	.988 18.298 18.327	61.315 18.327 569.700
15.00	6.368 6.694 17.103	1.436 -4.367 7.632	.683 .015 6.971	1.264 .312 7.010	18.029 1414.406 7.598	5.381 18.379 2.617	.983 18.317 18.348	61.617 18.348 570.045
19.98	6.457 6.664 16.962	1.452 -4.337 7.474	.691 .015 6.824	1.278 .375 6.879	17.966 1425.525 7.372	5.240 18.368 2.587	.980 18.313 18.340	61.587 18.340 570.045
24.96	6.546 7.172 16.835	1.475 -4.845 7.332	.691 .015 6.555	1.304 .381 6.680	17.960 1441.279 7.182	5.069 18.359 3.095	.979 18.294 18.326	62.095 18.326 569.355
30.05	6.637 6.914 16.713	1.494 -4.587 7.154	.705 .015 6.446	1.317 .401 6.462	17.941 1454.042 7.032	4.927 18.37[illegible] 2.827	.978 18.298 18.334	61.837 18.334 569.700

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
35.03	6.726 7.382 16.533	1.493 -5.055 7.150	.694 .014 6.330	1.322 .601 6.412	17.740 1453.257 6.930	4.880 18.365 3.305	.967 18.300 18.332	62.305 18.332 570.045
40.01	6.815 8.277 16.414	1.496 -6.150 7.220	.670 .014 6.134	1.338 .700 6.313	17.632 1455.411 6.867	4.828 18.368 4.400	.961 18.310 18.339	63.400 18.339 569.700
44.90	6.[illegible]4 7.107 16.064	1.436 -4.780 7.335	.673 .014 6.620	1.268 1.411 6.577	16.930 1413.886 6.917	5.058 18.380 3.020	.923 18.294 18.337	62.030 18.337 570.045
49.97	6.993 3.309 15.952	1.245 -.982 8.104	.655 .015 8.271	1.058 2.191 8.051	16.150 1272.882 8.571	6.278 18.366 -.768	.881 18.300 18.337	58.232 18.337 570.045
55.01	7.083 7.892 14.797	1.190 -5.565 8.567	.544 .015 7.808	1.058 3.451 7.872	14.890 1229.151 8.550	6.223 18.356 3.815	.812 18.299 18.328	62.815 18.328 570.045
59.99	7.172 8.315 13.235	1.147 -5.988 8.217	.516 .012 7.478	1.024 5.065 7.460	13.278 1194.293 8.024	5.862 18.367 4.238	.724 18.290 18.329	63.238 18.329 570.045
64.07	7.261 3.593 13.051	1.087 -1.266 8.005	.568 .013 8.085	.927 5.281 7.812	13.060 1144.502 7.859	6.212 18.325 -.484	.712 18.269 18.297	58.516 18.297 570.045

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
	7.351	1.113	.650	.903	14.563	6.696	.792	54.262
70.01	-.661	2.988	.015	3.819	1165.777	18.357	18.298	18.327
	14.501	8.372	9.254	8.668	8.658	-4.748	18.327	569.700
	7.440	1.190	.667	.985	16.339	6.826	.891	55.884
74.99	.961	1.366	.017	2.002	1229.425	18.369	18.311	18.340
	16.237	8.672	9.346	8.865	9.095	-3.116	18.340	570.734
	7.529	1.258	.655	1.072	17.627	6.736	.961	58.443
79.97	3.520	-1.193	.018	.715	1282.864	18.369	18.308	18.334
	17.380	8.765	8.900	8.809	8.981	-.567	18.334	570.045
	7.619	1.312	.638	1.147	18.112	6.426	.988	60.934
85.00	6.011	-3.684	.017	.229	1324.600	18.385	18.312	18.349
	17.695	8.741	8.259	8.504	8.581	1.934	18.349	570.045
	7.708	1.309	.658	1.131	18.053	6.438	.984	59.798
89.98	4.875	-2.548	.017	.289	1321.930	18.370	18.300	18.335
	17.652	8.694	8.499	8.370	8.564	.788	18.335	570.390
	7.797	1.312	.648	1.141	17.987	6.359	.976	60.404
94.96	5.481	-3.154	.017	.435	1324.258	18.347	18.300	18.324
	17.499	8.620	8.274	8.361	8.465	1.404	18.324	570.390
	7.887	1.347	.641	1.185	18.117	6.133	.988	61.594
100.00	6.871	-4.344	.016	.224	1359.108	18.359	18.269	18.314
	17.582	8.545	7.897	8.083	8.180	2.594	18.314	570.390

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
1.331	60.372	.927

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.658	1.157	17.003	5.881	570.045	1.354	1.014

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.649	1.152	16.695	5.842	570.045	1.350	1.323	60.607

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

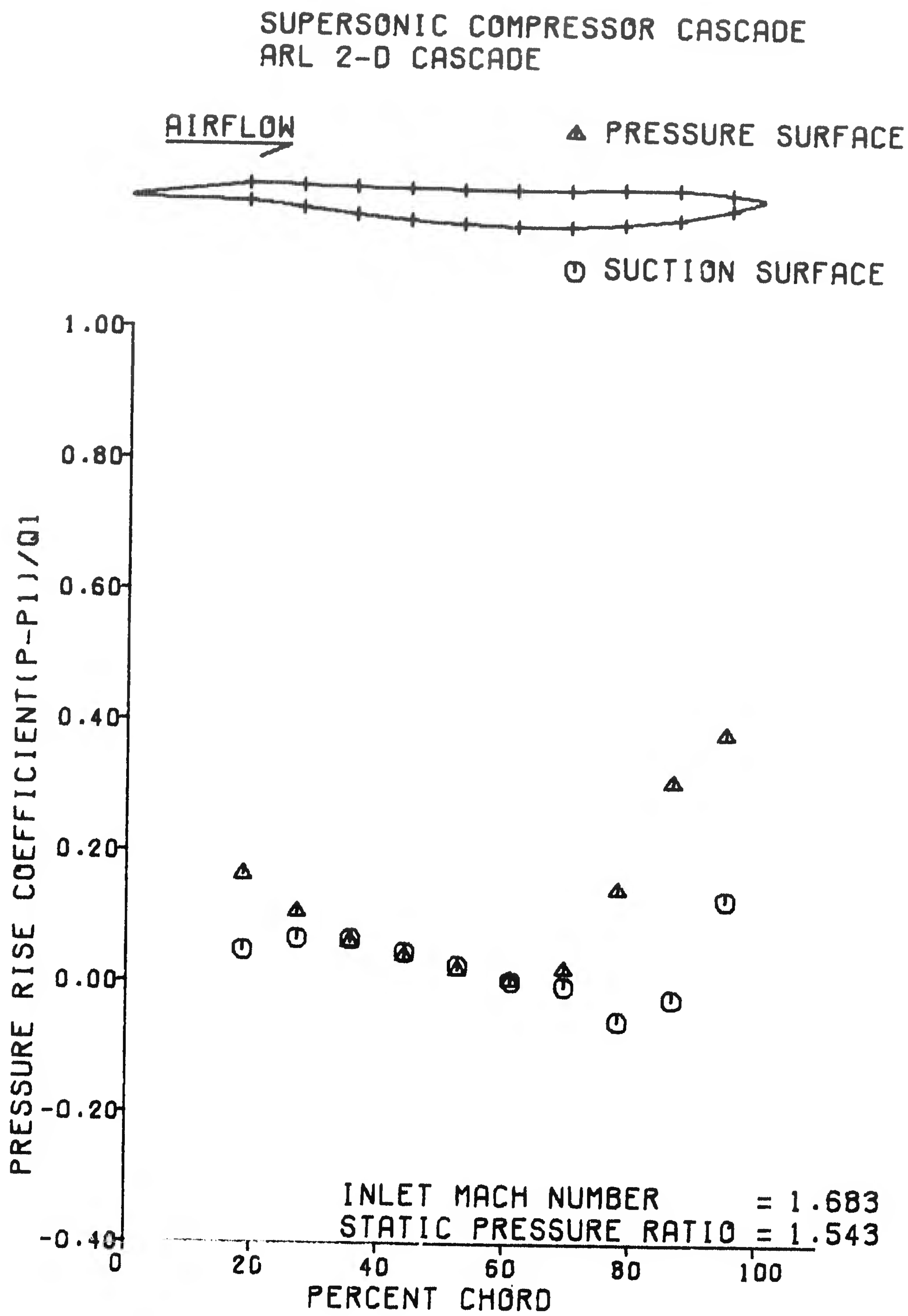
MASS AVERAGED EXIT CONDITIONS

P)2/P)1 TPLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
1.543	.927	.851	.777	.879	1.334	1.157	.092
.015	.183	1.343	.102	1.120	.274	5.449	-3.122
61.524	.964						

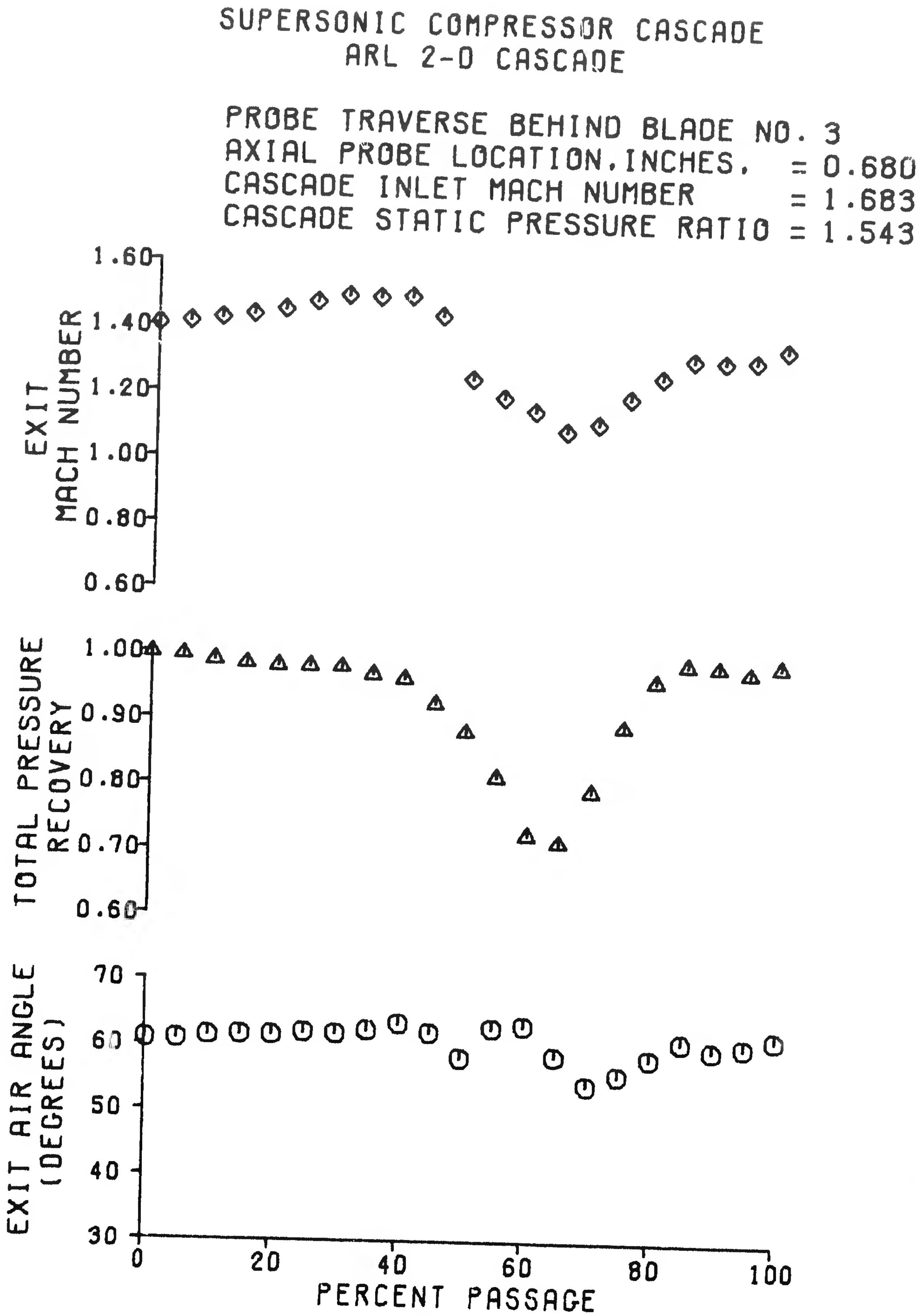
OVERALL PERFORMANCE

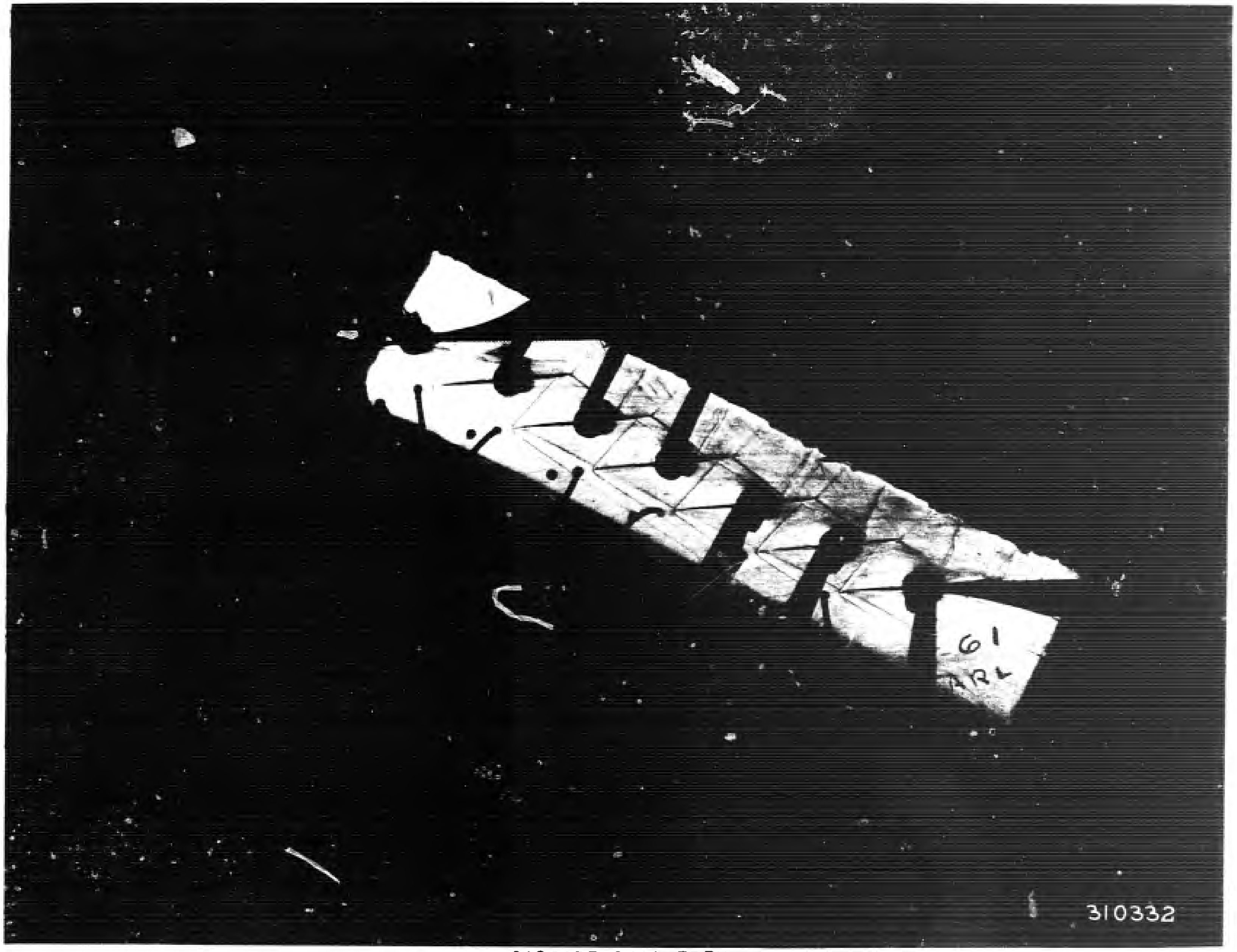
MIXED EXIT CONDITIONS

P)2/P)1 TPLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
1.533	.910	.847	.768	.877	1.321	1.161	.113
.018	.187	1.349	.103	1.101	.269	5.684	-3.357
61.063	.986						



SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
PRESSURE RISE COEFFICIENT(P-P1)/Q1
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.683
STATIC PRESSURE RATIO = 1.543


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION,INCHES, = 0.680
CASCADE INLET MACH NUMBER = 1.683
CASCADE STATIC PRESSURE RATIO = 1.543
EXIT MACH NUMBER
1.60
1.40
1.20
1.00
0.80
0.60
TOTAL PRESSURE RECOVERY
1.00
0.90
0.80
0.70
0.60
EXIT AIR ANGLE (DEGREES)
70
60
50
40
30
0
20
40
60
80
100
PERCENT PASSAGE



CASCADE SCHLIEREN

MN)1 = 1.683, P)2/P)1 = 1.543

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.683	1.777	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.410	18.398	18.397	18.409
11	17.637	4.573	5.073	4.174
13	8.709	4.765	4.643	4.317
15	8.442	4.533	4.296	4.331
17	8.241	4.539	4.139	4.193
19	8.360	4.781	3.979	4.017
21	18.343	18.375	4.008	3.834
23	5.258	5.100	4.183	3.780
25	5.600	5.090	5.248	3.376
27	5.824	3.795	6.456	3.657
29	6.925	3.782	7.083	4.857
31	7.249	4.008	18.416	18.414
33	5.178	3.710	6.379	4.139
35	5.235	3.715	6.667	6.011
37	7.227	4.247	6.490	6.834
39	5.887	4.962	7.125	4.609
41	7.118	4.957	4.450	4.719
43	4.541	1.290	3.847	4.579
45	18.363	1.239	2.985	1.220
47	18.381	18.402	18.397	18.391

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.892	1.501	30.990	26.984	571.079

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN1O	PT1O	TT1O	M1O	BETA1O
1.488	18.378	571.079	8.245	63.216

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.100	1.487
WEDGE	25	5.090	1.488
BLADE	27	3.795	1.687
BLADE	29	3.782	1.690
BLADE	31	4.008	1.651
BLADE	33	3.710	1.702
BLADE	35	3.715	1.701
BLADE	37	4.247	1.612

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.488	-5.765	36.448	1.683	1.008	.750

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
54.934	2.733	1.787	.025	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
50.947	53.797	52.932	54.923

274

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.683	18.378	571.079	57.250	3.818	.299	7.573

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
3.453	5.210	.911	1.416	1.567	4.813	1.100

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	6.238	33	6.178
25	6.500	35	6.235
27	6.824	37	7.227
29	6.925	39	6.887
31	7.249	41	7.116

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
6.771	.331	6.728	.441	1.285	1.773

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	4.962	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	4.957	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.689	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.719	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.579	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	553.493	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.228	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.046	PSIA
SECONDARY BLEED FLOW RATE	=	.246	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.032	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	5.073	3.174	.166	.047	.276	.227	10.65	10.64
13	4.643	4.317	.109	.066	.253	.235	27.14	27.15
15	4.296	4.331	.063	.068	.234	.236	35.64	35.64
17	4.139	4.193	.042	.049	.225	.228	44.09	44.12
19	3.979	4.017	.021	.026	.216	.219	52.62	52.62
21	4.008	3.834	.025	.002	.216	.209	61.11	61.10
23	4.183	3.786	.048	-.005	.228	.206	69.57	69.61
25	5.248	3.376	.189	-.059	.286	.184	78.08	78.13
27	6.456	3.057	.348	-.221	.351	.199	86.57	86.60
29	7.063	4.057	.431	.137	.385	.264	95.04	95.06

FC	FC1X	FC1Y	BETA1F	CD11	CL11	MC1LE	CP1LE
.097	-.081	.052	-32.044	-.020	.097	.469	72.987

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	V DEV PT1VP	MN12 TURN P1TP	MN1X,2 M12 P13P	MN1Y,2 CP1,2 P1AP	PT12 V12 P1SP	P12 PT1C BETA1P	PT12/PT11 PT1C PT11	BETA12 PT1C,A TT11
.00	6.120 7.805 17.433	1.359 -5.556 8.496	.621 .222 7.546	1.209 .363 7.662	18.015 1357.678 8.298	5.992 18.426 3.819	.962 18.339 18.373	62.615 18.373 571.424
4.98	6.180 7.027 17.383	1.357 -5.602 8.477	.619 .215 7.516	1.208 .424 7.548	17.954 1359.974 8.337	5.900 18.405 3.843	.977 18.334 18.372	62.882 18.372 571.079
9.96	6.278 8.554 17.256	1.349 -6.229 8.597	.602 .215 7.480	1.207 .588 7.687	17.790 1352.921 8.221	6.004 18.408 4.469	.968 18.368 18.388	63.479 18.388 572.734
15.00	6.368 9.216 17.135	1.356 -6.889 8.568	.591 .214 7.301	1.222 .686 7.514	17.692 1357.953 8.057	5.915 18.420 5.129	.963 18.342 18.382	64.139 18.382 571.424
19.98	6.457 9.306 17.153	1.362 -7.269 8.583	.592 .214 7.265	1.227 .644 7.545	17.734 1362.251 7.994	5.882 18.408 5.319	.965 18.346 18.377	64.319 18.377 571.079
24.96	6.546 10.138 17.069	1.372 -7.781 8.567	.579 .214 7.074	1.244 .688 7.442	17.690 1369.789 7.821	5.782 18.394 6.021	.963 18.340 18.367	65.031 18.367 571.079
30.05	6.637 9.480 16.942	1.374 -7.153 8.417	.594 .214 7.090	1.239 .811 7.395	17.567 1371.258 7.728	5.726 18.397 5.393	.956 18.337 18.367	64.403 18.367 571.079

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	V DEV PT1VP	MN12 TURN P1TP	MN1X,2 M12 P13P	MN1Y,2 CP1,2 P1AP	PT12 V12 P1SP	P12 PT1C BETA1P	PT12/PT11 PT1C PT11	BETA12 PT1C,A TT11
35.03	6.726 9.545 16.877	1.377 -7.218 8.413	.591 .214 7.080	1.235 .960 7.206	17.418 1369.764 7.554	5.603 18.395 5.465	.948 18.344 18.372	64.466 18.370 571.424
40.01	6.815 5.571 16.409	1.271 -3.174 8.484	.527 .215 8.151	1.125 1.612 8.208	15.766 1254.420 8.317	6.292 18.363 1.414	.912 18.360 18.372	62.424 18.372 572.734
44.99	6.924 5.795 16.052	1.176 -3.468 9.276	.575 .215 8.911	1.226 2.244 8.862	16.134 1219.232 9.294	5.864 18.415 1.706	.878 18.334 18.374	62.718 18.374 571.079
49.97	6.093 7.246 16.658	1.193 -4.919 9.495	.557 .215 8.773	1.055 1.610 8.892	15.768 1232.737 9.480	6.982 18.398 3.159	.912 18.339 18.368	62.169 18.368 572.114
55.01	7.083 6.473 15.121	1.115 -6.146 9.547	.490 .214 8.587	.997 3.233 8.828	15.145 1165.823 9.364	6.962 18.394 4.385	.824 18.337 18.365	63.396 18.365 571.424
59.99	7.172 8.775 13.408	.783 -6.446 9.549	.347 .212 8.962	.702 4.970 8.905	13.408 866.122 9.226	8.942 18.397 4.688	.730 18.295 18.346	63.695 18.346 570.392
64.97	7.261 5.475 13.132	.759 -3.149 9.372	.375 .212 9.209	.660 5.245 8.902	13.132 841.595 9.227	8.958 18.375 1.389	.715 18.336 18.355	62.399 18.355 571.769

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)C PT)1	BETA)2 PT)0,A TT)1
72.81	7.351 3.175 14.328	.879 -.848 9.139	.465 .814 9.277	.746 4.072 5.914	14.328 958.556 9.225	6.658 18.417 -.912	.772 18.327 18.372	33.898 18.372 571.879
74.00	7.442 3.815 16.839	1.179 -1.483 9.837	.512 .815 9.093	1.008 2.232 5.892	16.146 1221.824 9.139	5.848 18.397 -.272	.879 18.347 18.372	58.738 18.372 572.489
79.47	7.529 5.179 17.278	1.244 -2.882 8.848	.622 .216 8.693	1.278 1.998 8.773	17.279 1273.329 8.927	5.725 18.404 1.702	.940 18.374 18.389	60.182 18.389 572.308
85.30	7.619 6.127 17.551	1.294 -4.055 8.812	.621 .218 8.352	1.135 .477 8.556	17.921 1311.780 8.812	5.515 18.383 2.306	.974 18.312 18.345	61.306 15.345 571.424
89.98	7.708 6.763 17.848	1.380 -4.432 8.940	.521 .215 8.276	1.152 .332 8.400	15.949 1323.396 8.456	5.438 18.372 2.576	.982 18.325 18.349	61.586 18.349 570.392
94.95	7.797 6.222 17.811	1.318 -3.522 8.784	.536 .218 8.231	1.154 .337 8.331	18.741 1329.935 8.197	5.284 18.306 2.149	.987 18.314 18.364	61.152 18.356 571.769
102.82	7.842 5.817 17.625	1.322 -1.981 8.972	.468 .216 8.212	1.157 .290 8.253	18.780 1325.452 8.353	5.335 18.423 1.833	.984 18.318 18.361	62.533 18.341 571.404

277

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
1.229	62.812	.916

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.575	1.085	16.831	6.684	571.279	1.302	.977

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.563	1.075	16.608	6.765	571.279	1.292	1.229	62.768

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

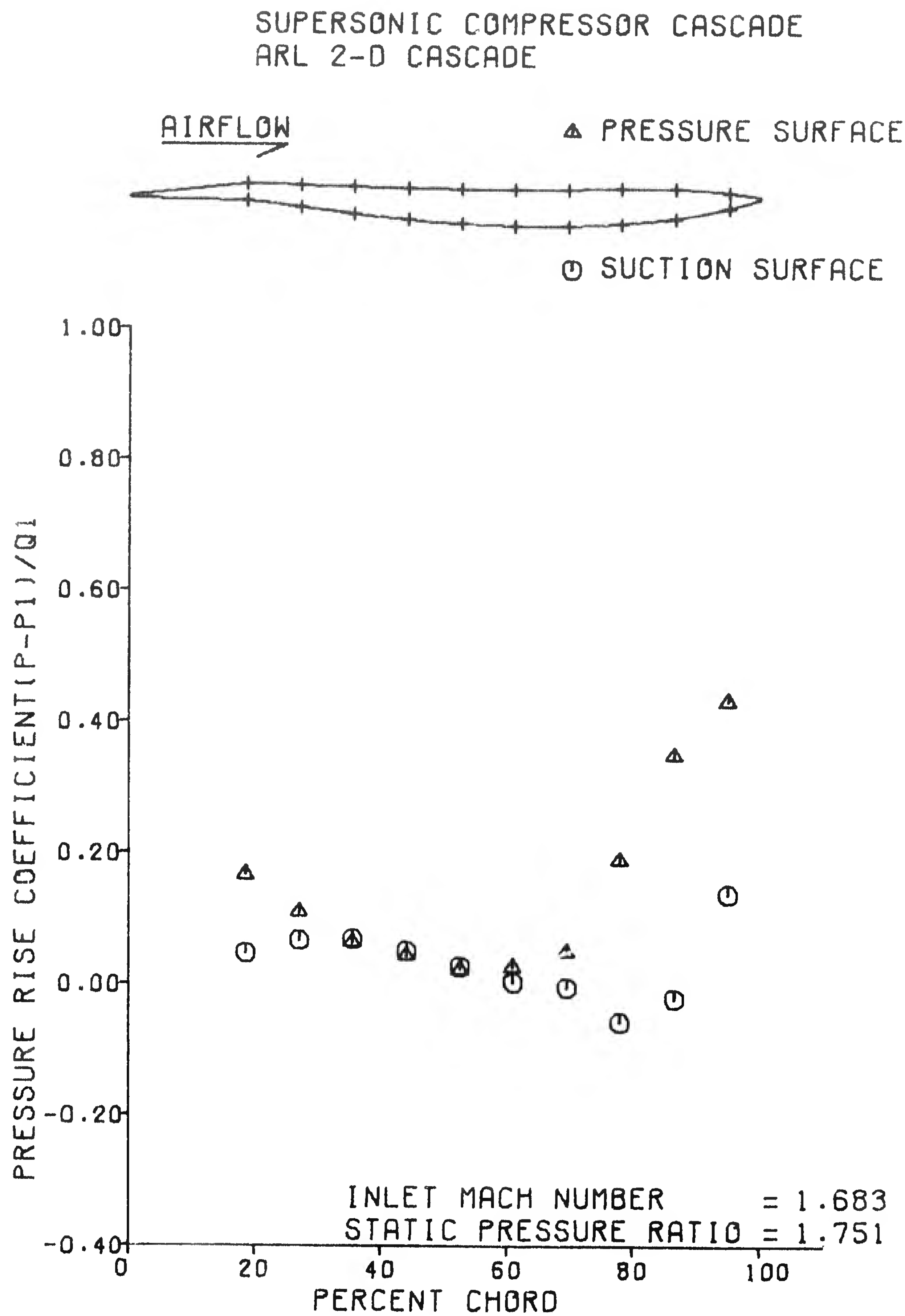
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.751	.916	.801	.694	.841	1.455	1.203	.106
.016	.243	1.435	.134	1.116	.378	7.096	-4.769
62.328	.990						

OVERALL PERFORMANCE

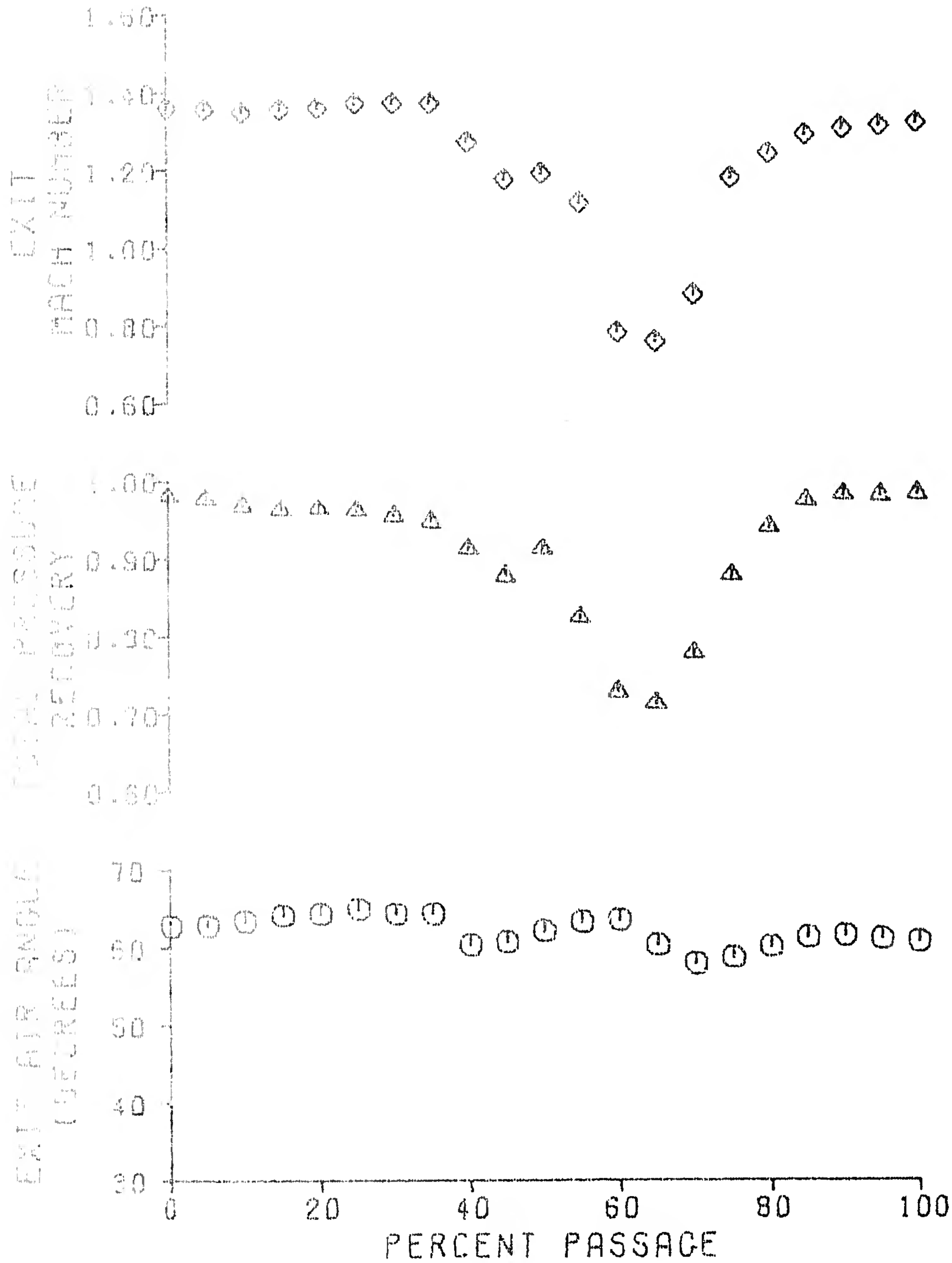
MIXED EXIT CONDITIONS

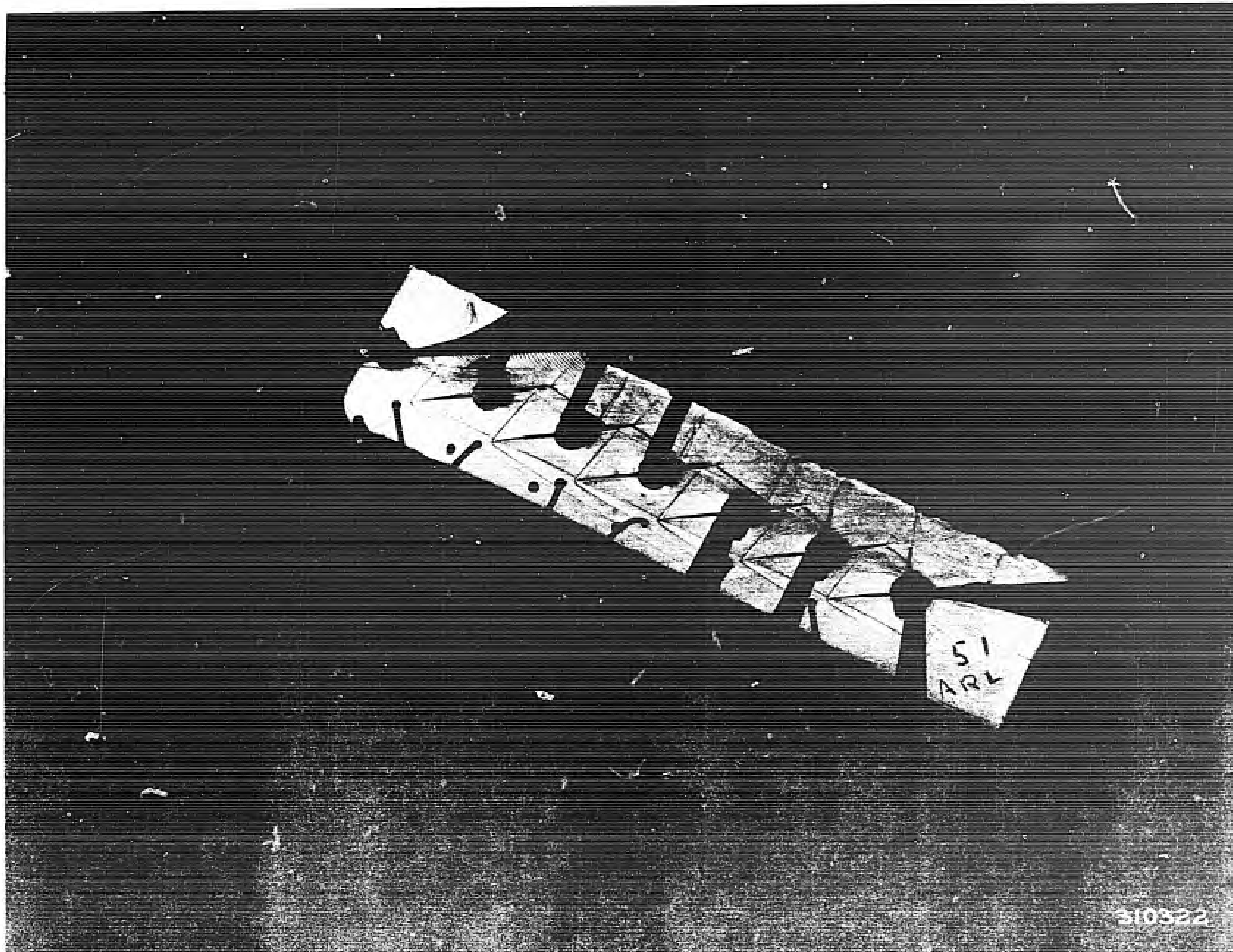
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.772	.904	.791	.669	.836	1.462	1.212	.122
.018	.254	1.454	.138	1.101	.389	7.865	-5.538
62.104	1.023						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
PRESSURE RISE COEFFICIENT(P-P1)/Q1
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.683
STATIC PRESSURE RATIO = 1.751

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.683
CASCADE STATIC PRESSURE RATIO = 1.751





CASCADE SCHLIEREN

MN)1 = 1.683, P)2/P)1 = 1.751

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.683	2.061	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	10.359	10.369	10.363	10.365
11	16.823	4.609	5.056	4.183
13	10.933	4.783	4.633	4.320
15	10.068	4.543	4.377	4.316
17	9.988	4.595	4.565	4.173
19	10.104	4.789	4.943	4.200
21	10.320	10.361	5.958	3.841
23	7.576	5.109	6.773	3.780
25	7.706	5.101	7.545	3.388
27	7.794	3.801	7.947	3.772
29	7.946	3.795	7.731	4.844
31	8.083	4.006	10.366	10.370
33	6.246	3.706	7.384	2.936
35	7.525	3.729	7.634	6.260
37	8.043	4.330	7.595	7.789
39	7.786	4.966	8.318	4.707
41	7.735	4.965	4.386	4.720
43	4.548	1.261	3.843	4.582
45	10.354	1.245	2.693	1.214
47	10.355	10.360	10.372	10.378

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.891	1.501	30.990	26.986	569.700

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN)O	PT)O	TT)O	M)O	BETA)O
1.488	10.345	569.700	8.240	63.014

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.109	1.485
WEDGE	25	5.101	1.486
BLADE	27	3.801	1.685
BLADE	29	3.795	1.686
BLADE	31	4.006	1.650
BLADE	33	3.706	1.702
BLADE	35	3.729	1.698
BLADE	37	4.330	1.598

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.488	-5.766	36.447	1.683	1.060	.750

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
56.934	2.733	1.787	.023	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
50.947	53.797	52.032	54.923

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.683	18.345	569.700	57.250	3.811	.299	7.559

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
3.453	5.218	.911	1.416	1.567	4.813	1.102

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	7.576	33	6.246
25	7.706	35	7.525
27	7.794	37	8.043
29	7.946	39	7.786
31	8.083	41	7.735

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
7.821	.178	7.467	.633	1.174	2.052

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	4.966	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	4.965	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.787	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.720	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.582	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	553.838	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.214	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.045	PSIA
SECONDARY BLEED FLOW RATE	=	.242	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.029	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	5.056	4.183	.165	.049	.276	.228	18.65	18.64
13	4.633	4.320	.109	.067	.253	.235	27.14	27.15
15	4.377	4.316	.075	.067	.239	.235	35.64	35.64
17	4.565	4.173	.100	.048	.249	.227	44.39	44.12
19	4.943	4.008	.150	.026	.269	.218	52.62	52.62
21	5.958	3.841	.284	.004	.325	.209	61.11	61.10
23	6.773	3.780	.392	-.004	.369	.206	69.57	69.61
25	7.545	3.388	.494	-.056	.411	.185	78.08	78.13
27	7.947	3.772	.547	-.005	.433	.206	86.57	86.60
29	7.731	4.844	.518	.137	.421	.264	95.04	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.211	-.177	.115	-32.849	-.001	.211	.149	70.791

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.30	6.100 5.847 17.531	1.147 -3.520 10.578	.560 .000 10.171	1.001 .758 10.091	17.587 1194.313 10.486	7.761 18.356 1.770	.959 18.293 18.324	60.770 18.324 570.045
4.98	6.189 5.666 17.460	1.146 -3.339 10.307	.563 .017 10.143	.998 .831 10.100	17.514 1192.855 10.462	7.746 18.340 1.589	.955 18.298 18.319	60.569 18.319 569.355
9.96	6.278 5.878 17.290	1.144 -3.551 10.433	.553 .017 10.023	.998 1.004 10.005	17.341 1191.381 10.397	7.687 18.381 1.811	.945 18.335 18.358	60.801 18.358 569.010
15.00	6.368 5.599 17.182	1.144 -3.272 10.307	.563 .017 9.963	.996 1.111 9.897	17.234 1191.748 10.312	7.636 18.362 1.522	.939 18.293 18.328	60.522 18.328 569.355
19.98	6.457 5.972 17.049	1.149 -3.645 10.194	.559 .016 9.769	1.004 1.240 9.787	17.105 1195.346 10.214	7.536 18.366 1.895	.932 18.297 18.332	60.895 18.332 567.976
24.96	6.546 6.078 16.808	1.150 -3.751 10.054	.558 .016 9.611	1.006 1.481 9.618	16.864 1196.658 10.036	7.415 18.362 2.001	.919 18.289 18.326	61.201 18.326 569.700
30.05	6.637 6.177 16.614	1.158 -3.850 9.867	.560 .016 9.406	1.014 1.667 9.425	16.678 1202.976 9.833	7.262 18.351 2.100	.909 18.302 18.327	61.100 18.327 570.045

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
35.03	6.726 6.510 16.511	1.170 -4.183 9.721	.560 .016 9.187	1.028 1.756 9.213	16.589 1213.042 9.699	7.110 18.350 2.433	.904 18.306 18.328	61.433 18.328 569.355
40.01	6.815 6.680 16.620	1.182 -4.353 9.563	.562 .015 8.984	1.040 1.631 9.037	16.714 1222.912 9.599	7.252 18.365 2.603	.911 18.322 18.344	61.603 18.344 569.355
44.99	6.904 7.294 15.949	1.173 -4.967 9.456	.547 .015 8.775	1.037 2.318 8.792	16.027 1214.900 9.413	6.849 18.370 3.287	.874 18.280 18.325	62.217 18.325 570.045
49.97	6.993 7.607 14.474	.927 -5.280 9.298	.428 .014 8.728	.822 3.870 8.640	14.474 1001.722 9.197	8.312 18.367 3.520	.789 18.313 18.340	62.530 18.340 569.010
55.01	7.083 5.746 13.430	.820 -3.419 9.119	.482 .013 8.899	.715 4.915 8.629	13.430 901.111 9.044	8.632 18.368 1.669	.732 18.300 18.334	60.669 18.334 569.355
59.99	7.172 3.144 13.628	.836 -.817 8.992	.442 .013 9.120	.710 4.716 8.697	13.528 916.392 9.064	8.619 18.371 -.933	.743 18.292 18.332	58.867 18.332 569.700
64.97	7.261 2.375 15.164	1.124 -.048 8.966	.607 .015 9.303	.946 3.151 8.882	15.194 1174.733 9.199	6.988 18.379 -1.702	.828 18.300 18.339	57.298 18.339 569.010

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.01	7.351 2.671 16.597	1.190 -.344 9.065	.638 .017 9.379	1.004 1.643 9.056	16.702 1228.752 9.317	6.981 18.376 -1.405	.910 18.323 18.349	57.594 18.349 570.390
74.99	7.440 3.105 17.097	1.193 -.778 9.317	.632 .017 9.540	1.012 1.135 9.355	17.210 1231.478 9.525	7.162 18.388 -.972	.938 18.321 18.354	58.023 18.354 569.700
79.97	7.529 3.391 17.114	1.171 -1.064 9.581	.615 .018 9.836	.906 1.150 9.704	17.195 1213.530 9.854	7.364 18.388 -.686	.937 18.302 18.345	58.314 18.345 569.700
85.00	7.619 3.482 17.008	1.145 -1.155 9.984	.600 .018 10.117	.975 1.286 9.989	17.059 1192.293 10.078	7.552 18.376 -.595	.930 18.317 18.346	58.405 18.345 569.355
89.98	7.708 3.656 16.922	1.127 -1.329 10.091	.587 .017 10.183	.961 .387 10.064	16.958 1177.037 10.189	7.684 18.375 -.421	.924 18.293 18.334	58.579 18.334 569.015
94.96	7.797 3.801 16.833	1.119 -1.474 10.079	.581 .017 10.141	.957 1.482 10.045	16.863 1171.101 10.149	7.709 18.337 -.286	.919 18.302 18.320	55.724 18.320 569.333
100.00	7.887 3.944 16.811	1.133 -1.517 10.004	.588 .017 10.034	.970 1.494 9.939	15.851 1182.143 10.071	7.576 18.366 -.133	.919 18.290 18.329	58.867 18.329 570.245

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
1.118	59.832	.899

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.562	.965	16.492	7.554	569.700	1.250	[illegible]

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.551	.953	16.421	7.597	569.700	1.246	1.129	62.231

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

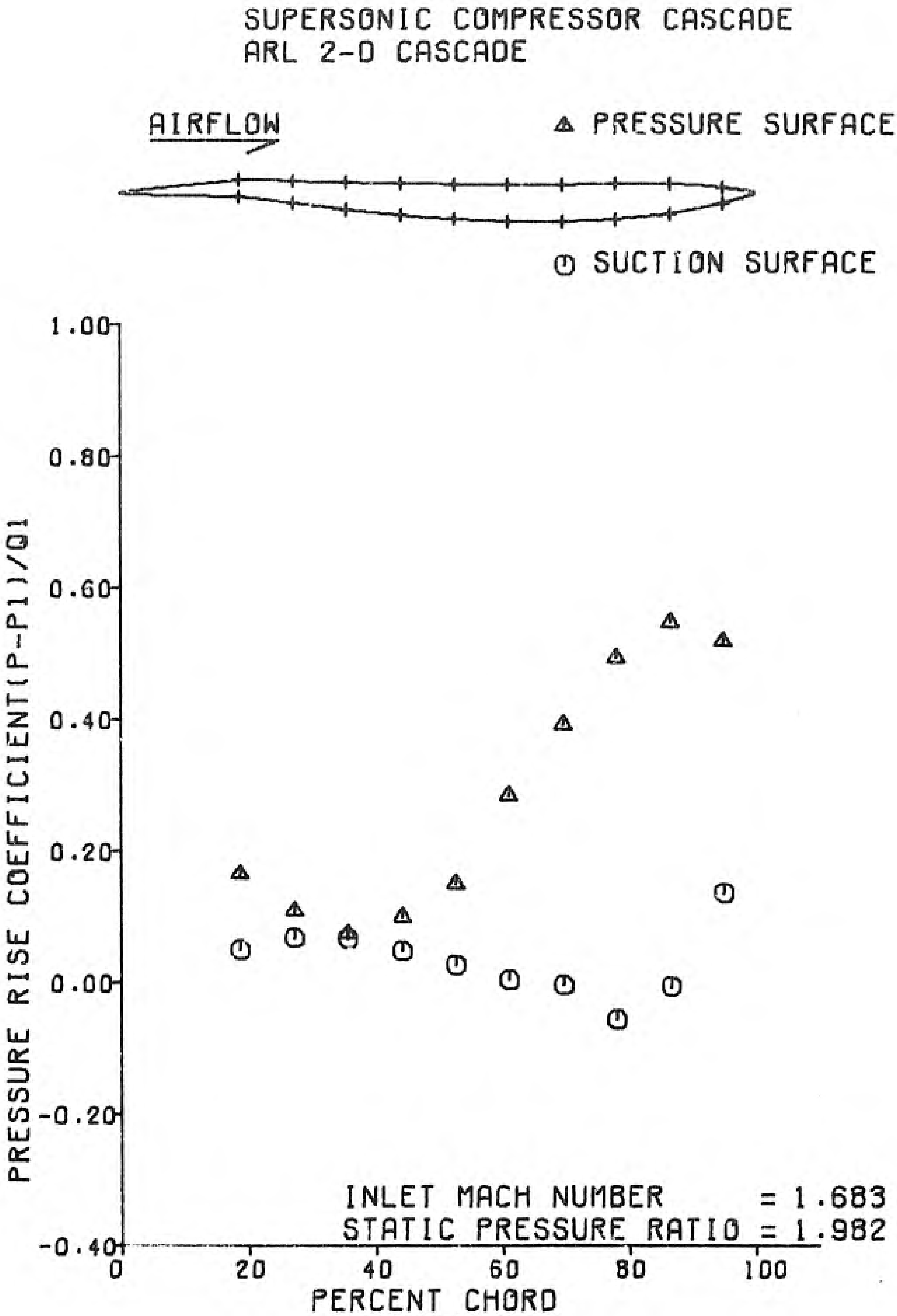
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.982	.899	.743	.691	.764	1.581	1.253	.128
.021	.321	1.564	.198	1.093	.495	4.909	-2.582
62.600	.916						

OVERALL PERFORMANCE

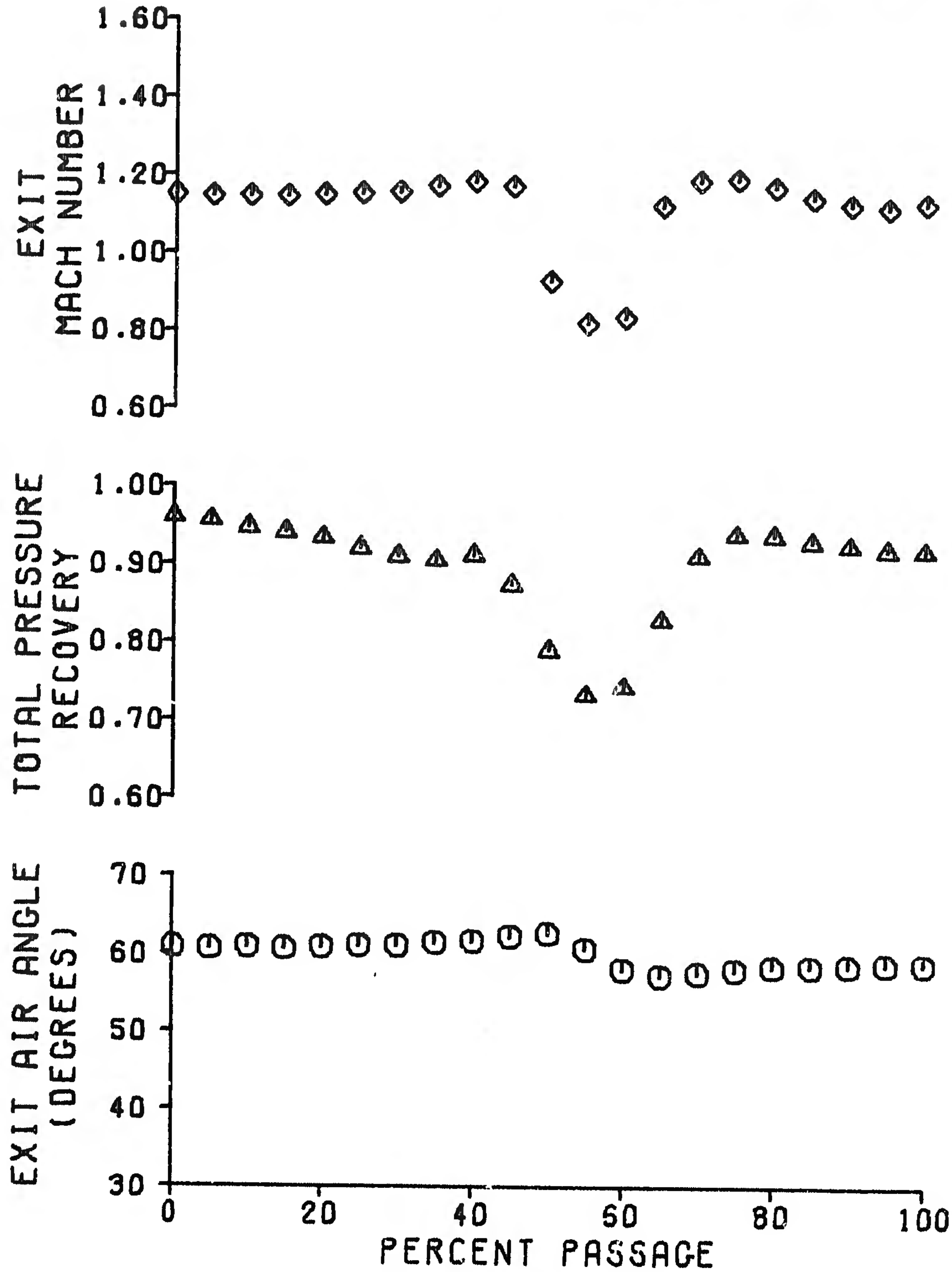
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.993	.894	.739	.678	.762	1.585	1.257	.134
.022	.327	1.575	.200	1.086	.501	5.308	-2.981
62.485	.930						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
PRESSURE RISE COEFFICIENT(P-P1)/Q1
INLET MACH NUMBER = 1.683
STATIC PRESSURE RATIO = 1.982
0
20
40
60
80
100
PERCENT CHORD

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES, = 0.680
CASCADE INLET MACH NUMBER = 1.683
CASCADE STATIC PRESSURE RATIO = 1.982



CASCADE SCHLIEREN

MN)1 = 1.683, P)2/P)1 = 1.982

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.683	2.413	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.392	18.367	18.398	18.391
11	18.323	4.617	8.492	4.473
13	9.973	4.807	7.351	4.634
15	10.356	4.778	6.426	4.684
17	10.034	4.602	6.664	4.698
19	10.207	4.814	8.171	5.487
21	18.324	18.376	9.685	7.867
23	9.038	5.114	9.380	8.530
25	9.084	5.110	8.946	8.102
27	9.163	6.018	8.235	6.959
29	9.223	5.465	8.340	6.385
31	9.253	5.243	18.395	18.399
33	8.893	5.172	8.995	2.484
35	9.052	6.634	9.096	8.534
37	9.229	6.660	9.302	9.380
39	9.112	4.970	9.430	4.930
41	9.261	4.965	4.377	4.994
43	4.830	1.297	3.788	4.990
45	18.352	1.274	3.104	1.249
47	18.392	18.378	18.372	18.363

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.888	1.501	30.990	26.981	570.390

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN)O	PT)O	TT)O	M)O	BETA)O
1.488	18.369	570.390	8.246	63.019

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.114	1.485
WEDGE	25	5.110	1.485
BLADE	27	6.018	1.370
BLADE	29	5.465	1.438
BLADE	31	5.243	1.468
BLADE	33	5.172	1.477
BLADE	35	6.634	1.300
BLADE	37	6.660	1.297

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSUR RATIO
1.488	-5.770	36.444	1.683	1.000	.749

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
58.034	2.733	1.787	.025	1.030	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
50.947	53.797	52.032	54.923

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.683	15.369	572.300	57.280	3.816	.299	7.569

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
3.453	5.218	.911	1.416	1.567	4.814	1.101

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.036	33	8.893
25	9.084	35	9.052
27	9.163	37	9.229
29	9.223	39	9.112
31	9.253	41	9.261

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/P)1)
9.152	.081	9.120	.132	1.049	2.399

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	4.970	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	4.965	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.930	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	4.994	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	4.990	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	552.459	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.249	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.050	PSIA
SECONDARY BLEED FLOW RATE	=	.259	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.031	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DFS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.492	4.473	.518	.087	.462	.244	18.65	18.64
13	7.351	4.634	.467	.108	.400	.252	27.14	27.15
15	6.426	4.684	.345	.115	.350	.255	35.64	35.64
17	6.664	4.698	.376	.117	.363	.256	44.09	44.12
19	8.171	5.487	.575	.221	.445	.299	52.62	52.62
21	9.685	7.867	.775	.535	.527	.428	61.11	61.10
23	9.380	8.530	.735	.623	.511	.464	69.57	69.61
25	8.946	8.102	.678	.566	.487	.441	78.08	78.13
27	8.235	6.959	.584	.415	.448	.379	86.57	86.60
29	8.340	6.305	.598	.329	.454	.343	95.04	95.06

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	PC)LE	CP)LE
.246	-.209	.130	-31.917	-.005	.246	.106	43.150

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
	6.100	.895	.487	.751	15.901	9.449	.866	57.020
.03	2.097	.230	.009	2.469	973.010	18.412	18.329	18.371
	15.901	9.867	10.208	9.950	10.066	-1.990	18.371	572.459
	6.189	.906	.498	.757	16.029	9.415	.873	56.689
4.98	1.766	.561	.017	2.341	983.006	18.385	18.336	18.360
	16.029	9.870	10.275	9.980	10.064	-2.321	18.360	571.079
	6.278	.924	.507	.773	16.156	9.301	.880	56.727
9.96	1.804	.523	.017	2.213	1000.058	18.394	18.328	18.361
	16.156	9.877	10.286	10.003	10.073	-2.283	18.361	570.734
	6.358	1.032	.562	.866	16.372	8.325	.891	57.037
15.00	2.114	.213	.018	1.907	1097.276	18.388	18.354	18.371
	16.372	9.894	10.288	10.036	10.082	-1.973	18.371	570.734
	6.457	1.490	.586	.919	16.533	7.836	.900	57.477
19.98	2.554	-.227	.018	1.836	1147.307	18.386	18.310	18.348
	16.520	9.935	10.257	10.040	10.054	-1.533	18.348	571.079
	6.546	1.111	.588	.942	16.641	7.691	.906	58.016
24.96	3.003	-.766	.017	1.728	1164.483	18.383	18.312	18.348
	16.617	9.938	10.151	10.027	10.032	-.994	18.348	570.734
	6.637	1.127	.582	.964	16.692	7.563	.909	58.875
30.05	3.052	-1.625	.017	1.677	1177.749	18.390	18.322	18.356
	16.658	9.942	9.969	9.975	9.932	-.125	18.356	571.079

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
	6.726	1.127	.565	.974	16.466	7.461	.896	59.863
35.03	4.040	-2.813	.017	1.903	1177.749	18.391	18.329	18.360
	16.432	9.903	9.721	9.882	9.791	.853	18.360	570.390
	6.815	.906	.444	.790	15.417	9.056	.839	60.667
40.01	5.744	-3.417	.016	2.952	983.206	18.381	18.339	18.360
	15.417	9.807	9.528	9.712	9.563	1.657	18.360	570.045
	6.904	.790	.399	.682	13.963	9.252	.760	59.693
44.00	4.770	-2.443	.014	4.407	871.834	18.403	18.325	18.363
	13.963	9.621	9.530	9.496	9.358	.693	18.363	570.390
	6.993	.735	.408	.611	13.275	9.272	.723	56.258
49.07	1.335	.992	.014	5.004	817.232	18.394	18.333	18.364
	13.275	9.392	9.704	9.365	9.331	-2.752	18.364	570.045
	7.083	.882	.472	.648	14.173	9.283	.772	53.912
55.01	-1.011	3.338	.015	4.196	883.342	18.385	18.327	18.356
	14.173	9.298	9.984	9.411	9.507	-5.089	18.356	570.393
	7.172	1.353	.606	.861	15.811	7.843	.861	54.863
59.99	-.060	2.387	.017	2.556	1115.246	18.361	18.332	18.346
	15.808	9.356	10.165	9.559	9.773	-4.147	18.346	570.390
	7.261	1.147	.544	.949	16.875	7.452	.919	55.866
64.97	.943	1.384	.018	1.494	1194.816	18.375	18.315	18.346
	16.822	9.525	10.215	9.733	10.013	-3.144	18.346	571.079

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y / DEV / PT)YP	MN)2 / TURN / F)TP	MN)X,2 / M)2 / P)BP	MN)Y,2 / CP)1,2 / P)MP	PT)2 / V)2 / P)SP	P)2 / PT)C / BETA)P	PT)2/PT)1 / PT)0 / PT)1	BETA)2 / PT)0,A / TT)1
70.01	7.351	1.137	.626	.949	16.871	7.545	.918	56.591
	1.668	.659	.019	1.498	1166.398	18.386	18.341	18.363
	16.828	9.712	10.241	9.843	10.158	-2.419	18.363	570.045
74.99	7.440	1.107	.602	.929	16.658	7.738	.907	57.053
	2.127	.200	.018	1.712	1161.102	18.384	18.340	18.362
	16.636	9.866	10.282	9.910	10.207	-1.950	18.362	570.734
79.97	7.529	1.053	.570	.886	16.484	8.177	.897	57.241
	2.318	.000	.018	1.886	1115.246	18.381	18.319	18.350
	16.481	9.921	10.282	9.940	10.233	-1.769	18.350	570.390
85.00	7.619	.982	.532	.825	16.412	8.857	.893	57.178
	2.255	.072	.018	1.958	1052.241	18.397	18.315	18.356
	16.412	9.941	10.292	9.978	10.225	-1.822	18.356	570.734
89.98	7.708	.929	.504	.780	16.359	9.368	.891	57.131
	2.208	.119	.018	2.010	1004.494	18.388	18.306	18.347
	16.359	9.962	10.305	9.997	10.225	-1.879	18.347	571.079
94.96	7.797	.927	.504	.778	16.285	9.348	.887	57.063
	2.140	.187	.017	2.085	1002.428	18.350	18.304	18.327
	16.285	9.963	10.316	10.015	10.212	-1.947	18.327	570.734
100.00	7.887	.927	.505	.778	16.318	9.363	.888	57.007
	2.004	.243	.018	2.051	1002.846	18.403	18.334	18.369
	16.318	9.981	10.345	10.029	10.225	-2.003	18.369	569.700

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN)2	BETA)2	PT)2/PT)1
.997	57.209	.874

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.540	.836	16.049	8.500	570.390	1.199	1.135

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.527	.834	15.975	8.574	570.390	1.195	.986	57.726

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

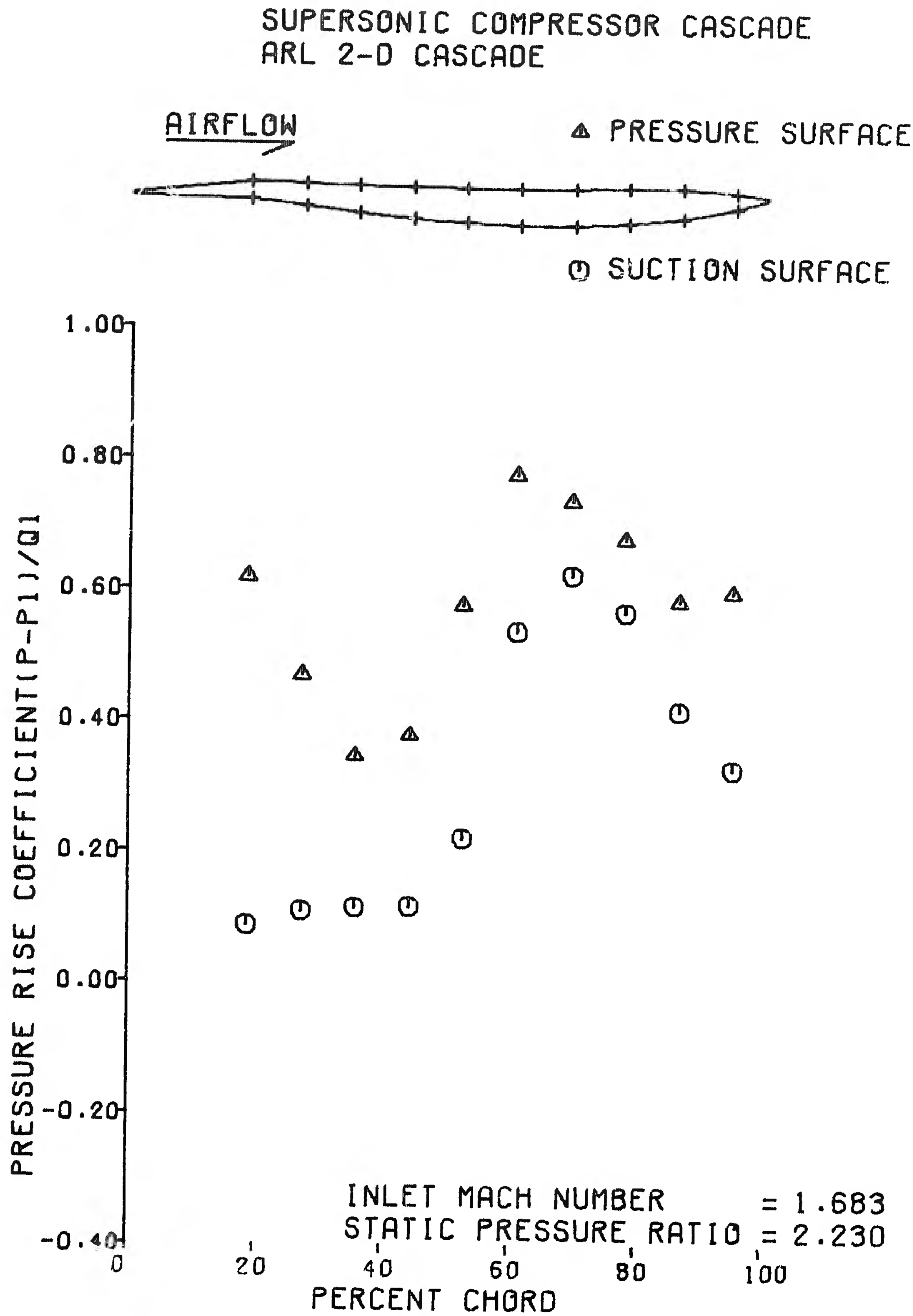
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.230	.874	.677	.678	.677	1.706	1.307	.159
.028	.412	1.741	.272	1.041	.620	2.286	.041
62.075	.665						

OVERALL PERFORMANCE

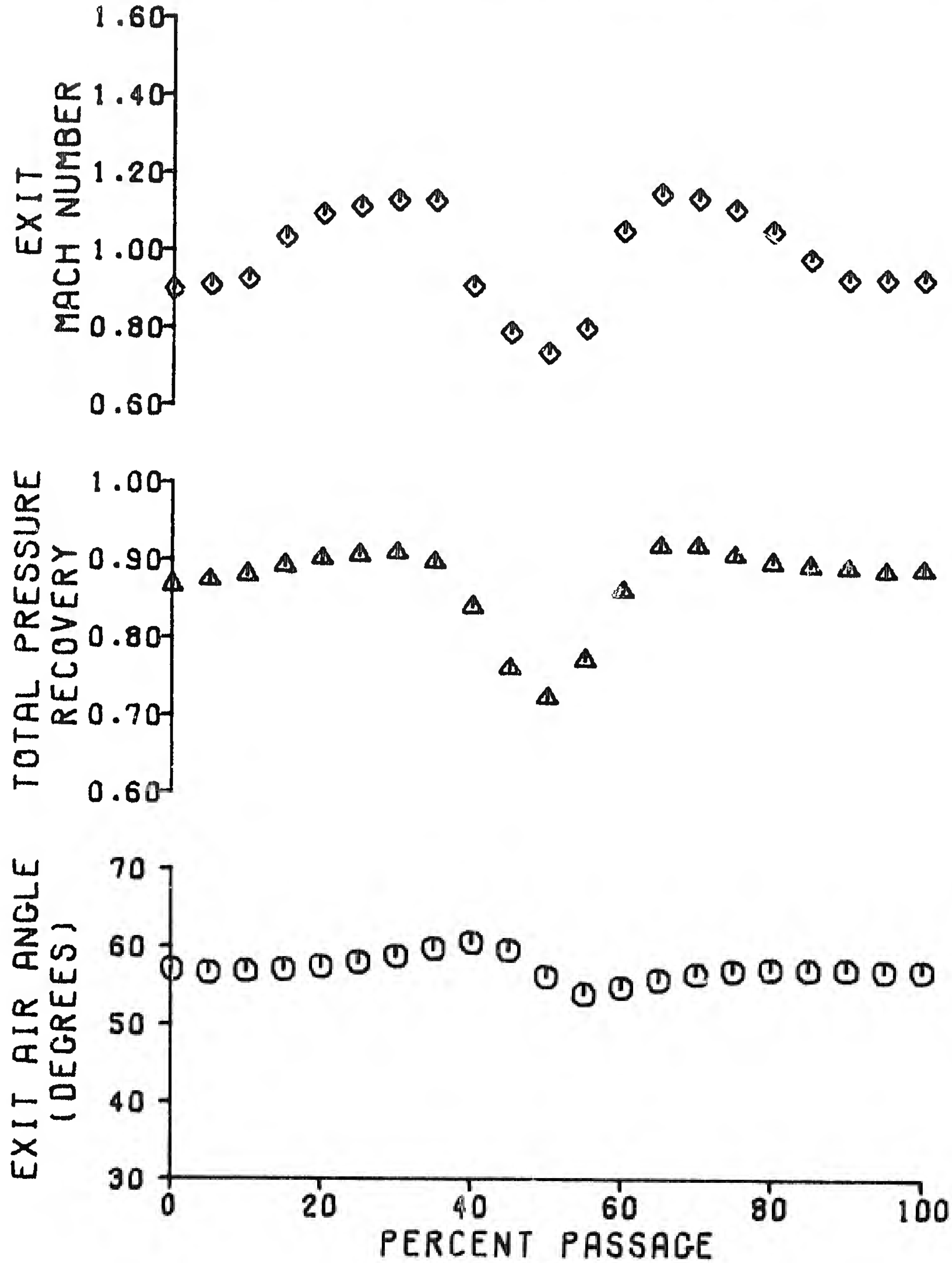
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.247	.870	.671	.662	.675	1.713	1.312	.165
.029	.418	1.757	.274	1.033	.629	2.803	-.476
61.929	.881						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
PRESSURE RISE COEFFICIENT(P-P1)/Q1
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.683
STATIC PRESSURE RATIO = 2.230

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.683
CASCADE STATIC PRESSURE RATIO = 2.230



CASCADE SCHLIEREN

MN)1 = 1.683, P)2/P)1 = 2.230

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.683	2.439	3	.680

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	18.383	18.400	18.384	18.401
11	18.448	4.611	8.518	4.370
13	18.047	4.809	7.409	4.520
15	18.428	4.833	6.516	4.584
17	18.101	4.594	6.747	4.674
19	18.285	4.822	8.269	5.736
21	18.309	18.381	9.721	7.975
23	9.126	5.113	9.383	8.685
25	9.162	5.107	8.972	8.163
27	9.243	6.085	8.300	6.989
29	9.305	5.721	8.458	6.300
31	9.331	5.824	18.365	18.383
33	8.830	5.040	9.084	2.481
35	9.106	6.758	9.185	8.639
37	9.298	6.846	9.428	9.431
39	9.218	4.965	9.668	4.964
41	9.422	4.963	4.373	5.049
43	4.898	1.279	3.749	5.066
45	18.347	1.256	3.099	1.228
47	18.350	18.354	18.359	18.376

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.892	1.501	30.990	26.979	569.700

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

NOZZLE EXIT CONDITIONS

MN1D	PT1D	TT1D	M1D	BETA1D
1.488	18.347	569.700	0.241	63.021

TEST SECTION AND CASCADE INLET PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

	SCANIVALVE PORT #	SCANIVALVE NO. 2	MACH NUMBER
WEDGE	23	5.113	1.484
WEDGE	25	5.107	1.485
BLADE	27	6.085	1.361
BLADE	29	5.721	1.405
BLADE	31	5.824	1.406
BLADE	33	5.040	1.494
BLADE	35	6.758	1.285
BLADE	37	6.846	1.275

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

WEDGE UPSTREAM MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.488	-5.771	35.443	1.683	1.000	.749

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
56.934	2.733	1.797	.025	1.000	1.000

INLET METAL ANGLE PS (DEGREES)	INLET METAL ANGLE SS (DEGREES)	INLET METAL ANGLE ML (DEGREES)	EXIT METAL ANGLE ML (DEG.)
50.947	53.797	52.032	54.923

CASCADE INLET CONDITIONS

MN11	PT11	TT11	BETA11	P11	M11	Q11
1.683	18.347	569.700	57.250	3.811	.299	7.560

I1SS	I1ML	MN1X,1	MN1Y,1	TT/T11	PT/P11	NR/10**6
3.453	5.218	.911	1.416	1.567	4.814	1.102

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.186	33	8.830
25	9.162	35	9.106
27	9.243	37	9.298
29	9.385	39	9.218
31	9.331	41	9.422

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P12/P11)
9.229	.085	9.175	.281	1.841	2.422

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

SECONDARY BLEED PERFORMANCE

NORTH SIDEWALL BLEED PLENUM PRESSURE	=	4.965	PSIA
SOUTH SIDEWALL BLEED PLENUM PRESSURE	=	4.963	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 1	=	4.964	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 2	=	5.049	PSIA
NOZZLE EXTENSION PLENUM PRESSURE 3	=	5.066	PSIA
SECONDARY BLEED ORIFICE TEMPERATURE	=	553.838	R
SECONDARY BLEED ORIFICE PRESSURE	=	1.228	PSIA
SECONDARY BLEED ORIFICE DELTA P	=	.047	PSIA
SECONDARY BLEED FLOW RATE	=	.248	LB/SEC
RATIO OF BLEED TO NOZZLE MASS FLOW RATE	=	.030	

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.518	4.370	.523	.074	.464	.238	18.65	18.64
13	7.409	4.520	.475	.094	.424	.246	27.14	27.15
15	6.516	4.584	.358	.102	.355	.250	35.64	35.64
17	6.747	4.674	.388	.114	.368	.255	44.09	44.12
19	8.269	5.736	.590	.255	.451	.313	52.62	52.62
21	9.721	7.975	.782	.551	.530	.435	61.11	61.10
23	9.383	8.685	.737	.645	.511	.473	69.57	69.61
25	8.972	8.143	.583	.576	.489	.445	78.08	78.13
27	8.300	6.989	.594	.420	.452	.381	86.57	86.60
29	8.458	6.300	.615	.329	.461	.343	95.04	95.06

FC	FC)X	FC)Y	BETA)E	CD)1	CL)1	MC)LE	CP)LE
.250	-.213	.132	-31.903	-.005	.250	.107	42.823

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)RP	MN)Y,2 CP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	6.100 1.933 15.775	.893 .304 9.826	.486 .900 10.185	.747 2.572 9.931	15.775 969.824 10.018	9.403 18.392 -2.154	.860 18.334 18.363	56.856 18.363 570.390
4.98	6.139 1.638 15.870	.895 .689 9.826	.493 .917 10.244	.747 2.477 9.946	15.870 972.422 9.998	9.431 18.387 -2.449	.865 18.318 18.353	56.561 18.353 570.734
9.96	6.278 1.650 15.985	.906 .677 9.837	.499 .917 10.261	.756 2.362 9.966	15.985 982.412 10.027	9.390 18.355 -2.437	.871 18.315 18.335	56.573 18.335 570.734
15.00	6.368 1.882 16.216	.928 .525 9.854	.509 .918 10.266	.776 2.131 10.017	16.216 1002.531 10.034	9.301 18.359 -2.285	.884 18.328 18.344	56.725 18.344 570.734
19.98	6.457 2.223 16.396	1.053 .104 9.888	.571 .918 10.266	.885 1.949 10.020	16.399 1114.572 10.031	8.133 18.401 -1.864	.894 18.321 18.361	57.146 18.361 570.390
24.96	6.546 2.760 16.510	1.087 -.433 9.913	.581 .918 10.189	.919 1.825 10.053	16.522 1144.152 10.021	7.859 18.391 -1.317	.901 18.335 18.363	57.683 18.363 570.734
30.05	6.637 3.520 16.594	1.114 -1.193 9.915	.583 .918 10.035	.949 1.728 10.014	16.620 1166.339 9.949	7.652 18.381 -.557	.906 18.328 18.355	58.443 18.355 570.390

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)RP	MN)Y,2 CP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
35.03	6.726 4.406 16.434	1.121 -2.169 9.887	.572 .917 9.798	.965 1.883 9.930	16.464 1172.125 9.822	7.515 18.379 .419	.897 18.329 18.354	59.419 18.354 570.390
40.01	6.815 5.158 15.485	.996 -2.831 9.811	.452 .916 9.630	.785 2.862 9.788	15.485 962.412 9.613	9.096 18.375 1.071	.844 18.314 18.345	60.081 18.345 571.079
44.99	6.904 4.178 14.096	.791 -1.851 9.670	.406 .914 9.658	.678 4.252 9.577	14.096 872.085 9.440	9.333 18.376 .091	.768 18.310 18.343	9.101 18.343 571.424
49.97	6.993 .652 13.549	.743 1.675 9.470	.420 .914 9.873	.613 4.798 9.472	13.549 825.334 9.447	9.388 18.382 -3.435	.738 18.310 18.346	55.575 18.346 570.390
55.01	7.083 -1.145 14.601	.820 3.472 9.393	.485 .916 10.130	.662 3.746 9.518	14.601 901.111 9.652	9.385 18.383 -5.232	.796 18.313 18.348	53.778 18.348 570.734
59.99	7.172 .086 16.136	1.083 2.241 9.479	.621 .917 10.292	.887 2.201 9.669	16.146 1140.258 9.928	7.724 18.365 -3.991	.880 18.323 18.344	55.009 18.344 571.079
64.97	7.261 1.034 17.024	1.147 1.293 9.649	.642 .918 10.327	.951 1.270 9.826	17.077 1194.261 10.149	7.537 18.401 -3.053	.931 18.332 18.367	55.957 18.367 571.079

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)8P	MN)Y,2 CP)1,2 P)HP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.01	7.351 1.738 16.055	1.133 .597 9.822	.623 .819 10.339	.946 1.353 9.945	16.995 1182.152 10.278	7.641 18.398 -2.347	.928 18.337 18.368	56.653 18.368 578.398
74.99	7.440 2.145 16.706	1.088 .182 9.954	.591 .818 10.364	.913 1.629 9.908	16.718 1144.341 10.316	7.958 18.374 -1.932	.911 18.328 18.351	57.088 18.351 571.879
79.97	7.520 2.386 16.559	1.053 .821 10.000	.578 .818 10.372	.885 1.788 10.011	16.562 1114.572 10.313	8.216 18.391 -1.771	.903 18.312 18.351	57.229 18.351 571.424
85.00	7.619 2.177 16.500	.931 .150 10.028	.586 .818 10.380	.782 1.847 10.053	16.508 1005.602 10.327	9.428 18.382 -1.910	.899 18.313 18.347	57.100 18.347 570.845
89.98	7.708 2.156 16.458	.925 .171 10.033	.584 .818 10.387	.779 1.879 10.078	16.468 1002.414 10.313	9.447 18.374 -1.931	.898 18.312 18.343	57.079 18.343 570.845
94.96	7.797 2.154 16.441	.925 .173 10.047	.583 .818 10.398	.776 1.906 10.090	16.441 959.560 10.305	9.453 18.383 -1.923	.896 18.316 18.348	57.077 18.348 571.079
100.00	7.887 1.968 16.431	.925 .359 10.051	.585 .818 10.435	.775 1.916 10.122	16.431 1000.006 10.299	9.452 18.374 -2.100	.896 18.338 18.356	56.891 18.356 570.398

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

MASS AVERAGED EXIT CONDITIONS

MN12	BETA12	PT12/PT11
.984	57.818	.878

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.538	.825	16.100	8.664	569.700	1.194	1.147

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.524	.822	16.233	8.724	569.700	1.190	.974	57.490

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

OVERALL PERFORMANCE

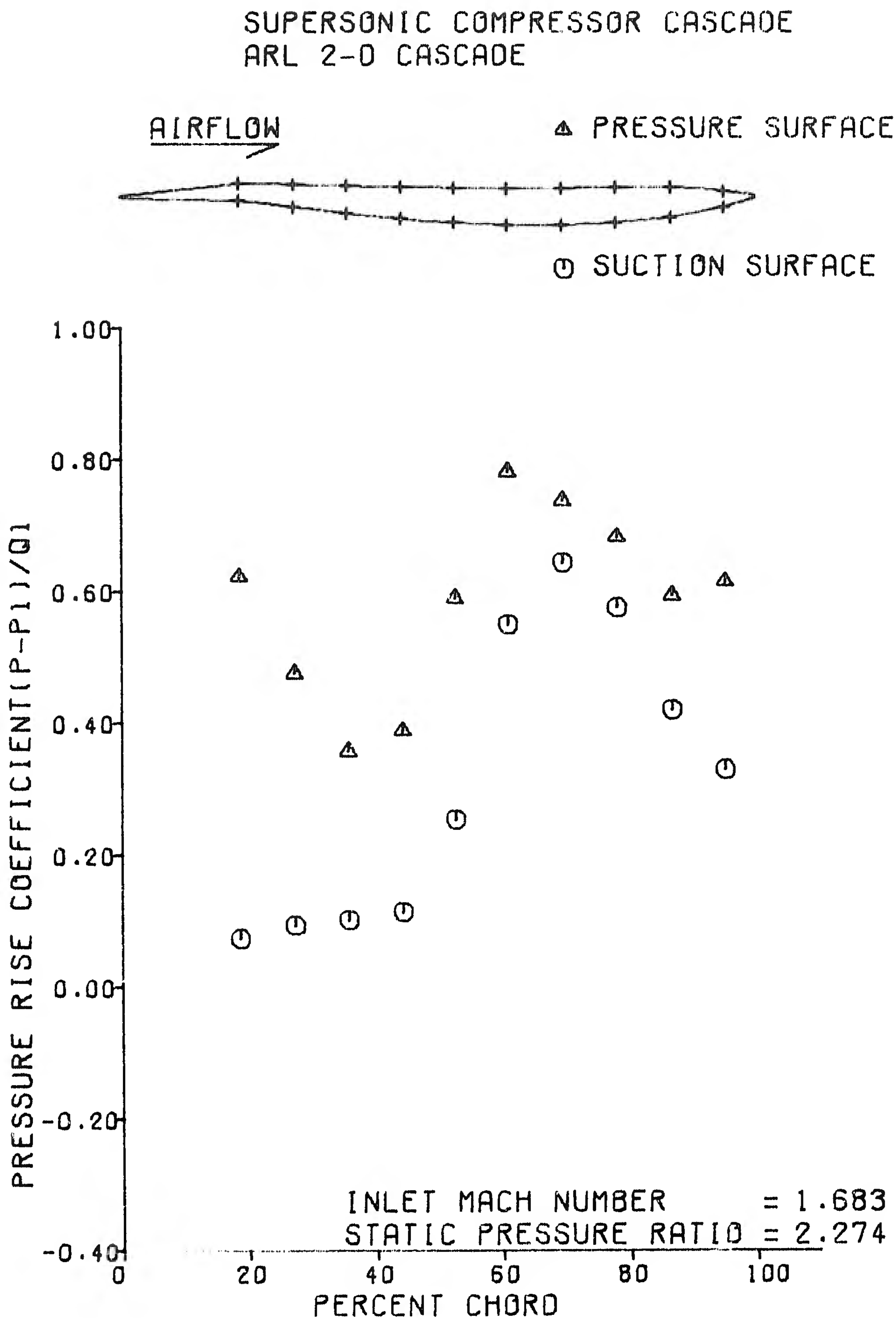
MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.274	.878	.670	.674	.668	1.732	1.313	.155
.028	.422	1.762	.279	1.042	.642	2.095	.232
62.202	.857						

OVERALL PERFORMANCE

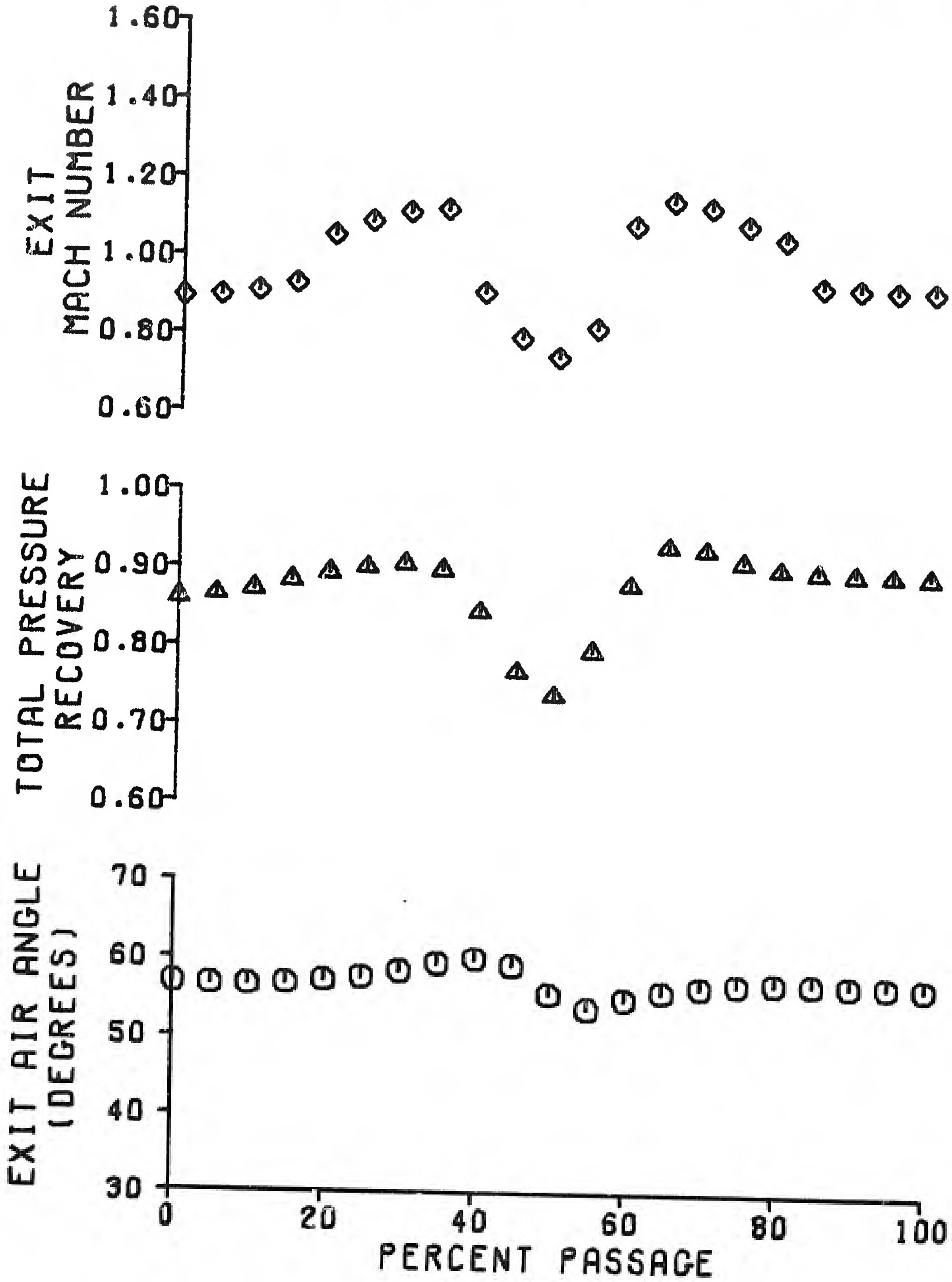
MIXED EXIT CONDITIONS

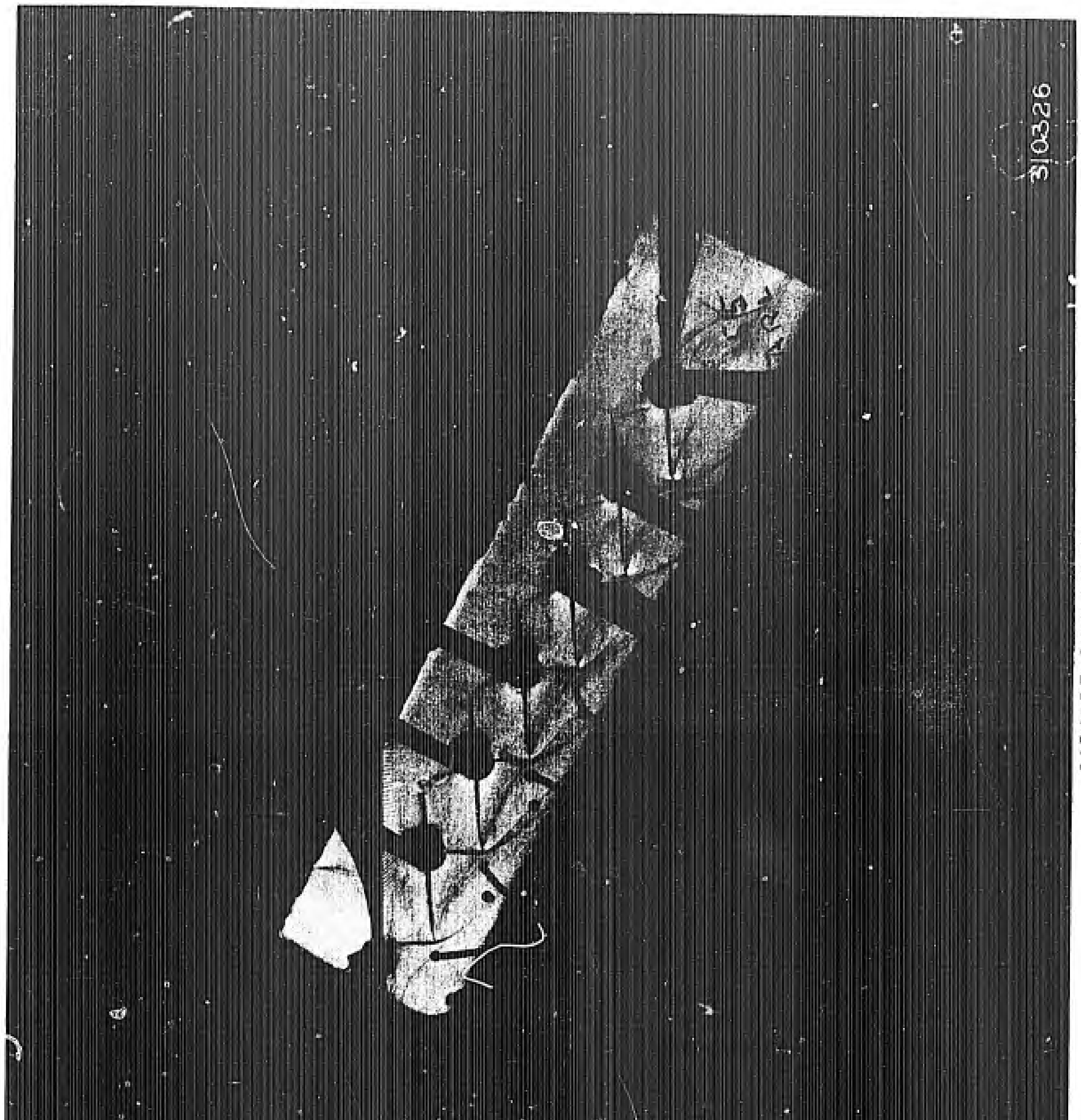
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.289	.874	.664	.662	.666	1.739	1.317	.159
.028	.428	1.777	.281	1.035	.654	2.567	-.240
62.066	.872						


SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE
AIRFLOW
PRESSURE SURFACE
SUCTION SURFACE
PRESSURE RISE COEFFICIENT(P-P1)/Q1
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
0
20
40
60
80
100
PERCENT CHORD
INLET MACH NUMBER = 1.683
STATIC PRESSURE RATIO = 2.274

SUPERSONIC COMPRESSOR CASCADE
ARL 2-D CASCADE

PROBE TRAVERSE BEHIND BLADE NO. 3
AXIAL PROBE LOCATION, INCHES. = 0.680
CASCADE INLET MACH NUMBER = 1.683
CASCADE STATIC PRESSURE RATIO = 2.274





CASCADE SCHLIEREN

MN)1 = 1.683, P)2/P)1 = 2.274

APPENDIX G

LASER VELOCIMETER DATA - CASCADE INTERPASSAGE TRAVERSE PLANES A-A', B-B', C-C' AND D-D'

LASER VELOCIMETER DATA FOR INTERPASSAGE TRAVERSE PLANE A-A'

Data Point Identification (Ref. Figure 15)	Measurement Location - Inches Tangentially From Blade #3 Chord	Measurement Location-% Chord Spacing	Blue Line Velocity Component (Ft/Sec)	Green Line Velocity Component (Ft/Sec)	Axial Velocity (Ft/Sec)	Tangential Velocity (Ft/Sec)	Resultant Velocity (Ft/Sec)	Flow Direction -Ref. Axial- (Degrees)
			Cascade Static Pressure Ratio = 1.468					
A_0	0.140	7.84	997.9	983.7	695.2	1216.6	1401.2	60.3
A_1	0.292	16.34	1002.7	959.5	706.3	1194.6	1387.8	59.4
A_2	0.444	24.84	1002.3	983.2	693.6	1217.3	1404.1	60.1
A_3	0.596	33.34	998.9	958.8	702.9	1192.9	1384.6	59.5
A_4	0.748	41.84	1015.0	959.0	718.3	1197.4	1396.3	59.0
A_5	0.900	50.34	999.3	956.0	704.0	1190.3	1382.9	59.4
A_6	1.052	58.85	998.7	983.4	696.0	1216.5	1401.6	60.2
A_7	1.203	67.35	1003.5	987.3	699.6	1221.6	1407.8	60.2
A_8	1.355	75.85	1002.3	989.5	697.9	1223.4	1408.7	60.3
A_9	1.507	84.35	1005.4	991.1	700.4	1225.8	1411.8	60.3
A_{10}	1.659	92.85	1008.1	989.3	703.4	1224.8	1412.4	60.1
			Cascade Static Pressure Ratio = 2.220					
A_0	0.140	7.84	934.7	949.0	643.7	1166.2	1332.0	61.1
A_1	0.292	16.34	958.2	952.6	665.4	1175.9	1351.1	60.5
A_2	0.444	24.84	956.9	951.4	664.4	1174.5	1349.4	60.5
A_3	0.596	33.34	972.5	951.1	679.5	1178.4	1360.3	60.0
A_4	0.748	41.84	961.6	951.3	669.0	1175.6	1352.6	60.4
A_5	0.900	50.34	962.9	951.9	670.1	1176.6	1354.0	60.3
A_6	1.052	58.85	942.6	958.8	648.7	1177.7	1344.5	61.2
A_7	1.203	67.35	971.4	952.5	678.1	1179.4	1360.5	60.1
A_8	1.355	75.85	978.1	957.6	683.2	1186.2	1368.8	60.1
A_9	1.507	84.35	975.6	983.2	67.39	1210.1	1385.1	60.9
A_{10}	1.659	92.85	975.6	983.9	673.7	1210.8	1385.6	60.9

NOTE:

1. Cascade inlet operating conditions are presented in Table VII
2. Traverse plane A-A' is located 0.0449 inches downstream of the leading edge plane in the chordwise direction (1.64% of chord) as shown in Figure 14
3. LV data obtained using 0.3 micron mean diameter alumina seed material

TABLE XVIII
LASER VELOCIMETER DATA FOR INTERPASSAGE TRAVERSE PLANE B-B'

Data Point Identification (Ref. Figure 16)	Measurement Location - Inches Tangentially From Blade #3 Chord	Measurement Location-% Chord Spacing	Blue Line Velocity Component (Ft/Sec)	Green Line Velocity Component (Ft/Sec)	Axial Velocity (Ft/Sec)	Tangential Velocity (Ft/Sec)	Resultant Velocity (Ft/Sec)	Flow Direction -Ref. Axial- (Degrees)
			Cascade Static Pressure Ratio = 1.468					
B_0	0.247	13.80	1002.0	985.3	698.8	1219.2	1405.3	60.2
B_1	0.399	22.30	1017.4	987.2	713.0	1225.3	1417.6	59.8
B_2	0.550	30.80	1015.5	987.3	711.2	1224.8	1416.3	59.9
B_3	0.702	39.30	1013.2	985.5	709.4	1222.5	1413.4	59.9
B_4	0.854	47.80	1018.6	989.0	713.7	1227.3	1419.7	59.8
B_5	1.006	56.30	1019.2	989.7	714.1	1228.1	1420.6	59.8
B_6	1.158	64.80	1016.3	988.9	711.4	1226.6	1418.0	59.9
B_7	1.310	73.30	996.1	962.2	699.3	1195.4	1384.9	59.7
B_8	1.462	81.80	1024.6	951.1	729.7	1192.5	1398.0	58.5
B_9	1.614	90.30	1014.0	949.6	719.9	1188.1	1389.2	58.8
			Cascade Static Pressure Ratio = 2.220					
B_0	0.247	13.80	973.9	947.7	681.8	1175.5	1358.9	59.9
B_1	0.399	22.30	965.6	952.8	672.5	1178.1	1356.5	60.3
B_2	0.550	30.80	978.2	956.5	683.6	1185.2	1368.2	60.0
B_3	0.702	39.30	979.4	962.4	683.2	1191.1	1373.1	60.2
B_4	0.854	47.80	989.3	962.1	692.7	1193.5	1379.9	59.9
B_5	1.006	56.30	974.9	949.4	682.3	1177.4	1360.8	59.9
B_6	1.158	64.80	940.6	918.4	657.6	1138.3	1314.6	60.0
B_7	1.310	73.30	924.6	901.7	646.8	1117.9	1291.5	60.0
B_8	1.462	81.80	909.4	894.5	634.1	1106.9	1275.6	60.2
B_9	1.614	90.30	907.5	829.7	649.8	1043.9	1229.6	58.1

NOTE:

1. Cascade inlet operating conditions are presented in Table VII
2. Traverse plane B-B' is located 0.846 inches downstream of the leading edge plane in the chordwise direction (30.95% chord) as shown in Figure 14
3. LV data obtained using 0.3 micron mean diameter alumina seed material

TABLE XIX
LASER VELOCIMETER DATA FOR INTERPASSAGE TRAVERSE PLANE C-C'

Data Point Identification (Ref. Figure 17)	Measurement Location Inches Tangentially From Blade #3 Chord	Measurement Location-% Chord Spacing	Blue Line Velocity Component (Ft/Sec)	Green Line Velocity Component (Ft/Sec)	Axial Velocity (Ft/Sec)	Tangential Velocity (Ft/Sec)	Resultant Velocity (Ft/Sec)	Flow Direction -Ref. Axial- (Degrees)
Cascade Static Pressure Ratio = 1.468								
C_0	0.294	16.45	1002.1	927.5	714.4	1163.7	1365.5	58.5
C_1	0.385	21.55	1001.9	956.0	706.6	1191.0	1384.8	59.3
C_2	0.476	26.66	999.6	907.1	717.6	1143.3	1349.8	57.9
C_3	0.568	31.76	967.7	924.7	682.0	1151.6	1338.4	59.4
C_4	0.659	36.86	981.2	946.6	689.2	1176.4	1363.4	59.6
C_5	0.750	41.97	1004.8	950.8	710.7	1186.8	1383.4	59.1
C_6	0.841	47.07	1016.7	949.6	722.5	1188.9	1391.2	58.7
C_7	0.932	52.17	1020.5	951.6	725.6	1191.8	1395.4	58.7
C_8	1.024	57.28	1035.9	951.0	740.6	1195.4	1406.2	58.2
C_9	1.145	62.38	1026.5	949.2	732.1	1191.1	1378.1	58.4
C_{10}	1.206	67.48	1024.7	935.5	734.1	1177.4	1387.5	58.1
Cascade Static Pressure Ratio = 2.220								
C_0	0.294	16.45	900.7	895.9	625.3	1105.9	1270.4	60.5
C_1	0.385	21.55	893.4	897.3	617.9	1105.2	1266.2	60.8
C_2	0.476	26.66	906.6	896.3	630.8	1107.9	1274.9	60.3
C_3	0.568	31.76	907.9	878.4	637.0	1091.0	1263.3	59.7
C_4	0.659	36.86	905.1	894.3	630.0	1105.5	1272.4	60.3
C_5	0.750	41.97	909.8	890.4	635.5	1103.0	1273.0	60.1
C_6	0.841	47.07	909.0	886.6	635.8	1099.2	1269.8	60.0
C_7	0.932	52.17	906.2	888.8	632.5	1100.5	1269.3	60.1
C_8	1.024	57.28	907.3	831.0	649.2	1045.1	1230.3	58.2
C_9	1.145	62.38	905.2	832.7	646.7	1046.2	1229.9	58.3
C_{10}	1.206	67.48	904.3	832.6	645.9	1045.9	1229.2	58.3

NOTE:

1. Cascade inlet operating conditions are presented in Table VII
2. Traverse plane C-C' is located 1.651 inches downstream of the leading edge plane in the chordwise direction (60.4% chord) as shown in Figure 14
3. LV data obtained using 0.3 micron mean diameter alumina seed material

TABLE XX
LASER VELOCIMETER DATA FOR INTERPASSAGE TRAVERSE PLANE D-D'

Data Point Identification (Ref. Figure 18)	Measurement Location - Inches Tangentially From Blade #3 Chord	Measurement Location-% Chord Spacing	Blue Line Velocity Component (Ft/Sec)	Green Line Velocity Component (Ft/Sec)	Axial Velocity (Ft/Sec)	Tangential Velocity (Ft/Sec)	Resultant Velocity (Ft/Sec)	Flow Direction -Ref. Axial- (Degrees)
Cascade Static Pressure Ratio = 1.468								
D_0	0.432	24.15	961.4	917.4	678.0	1143.0	1328.9	59.3
D_1	0.523	29.25	1002.2	944.3	709.9	1179.8	1377.0	59.0
D_2	0.614	34.36	1037.7	948.6	743.0	1193.6	1406.0	58.1
D_3	0.705	39.46	1048.6	950.3	753.0	1198.2	1415.1	57.9
D_4	0.796	44.56	1043.5	948.9	748.5	1195.4	1410.4	58.0
D_5	0.888	49.67	1061.3	951.5	764.9	1202.8	1425.4	57.6
D_6	0.979	54.77	1046.5	955.8	749.5	1202.9	1417.3	58.1
D_7	1.070	59.87	1045.2	951.9	749.3	1198.8	1413.7	58.0
D_8	1.161	64.98	1043.1	950.8	747.6	1197.1	1411.4	58.0
D_9	1.252	70.08	1037.0	952.4	741.3	1197.1	1408.0	58.2
D_{10}	1.344	75.12	1024.1	946.7	730.4	1188.1	1394.7	58.4
Cascade Static Pressure Ratio = 2.220								
D_0	0.432	24.15	871.1	831.3	614.3	1035.6	1204.1	59.3
D_1	0.523	29.25	874.8	832.7	617.4	1038.0	1207.7	59.3
D_2	0.614	34.36	887.2	829.4	630.3	1038.2	1214.5	58.7
D_3	0.705	39.46	871.4	828.2	615.4	1032.8	1202.2	59.2
D_4	0.796	44.56	860.8	826.0	605.8	1027.7	1199.0	59.5
D_5	0.888	49.67	858.5	820.6	605.0	1021.9	1187.6	59.4
D_6	0.979	54.77	859.3	818.9	606.3	1020.5	1187.0	59.3
D_7	1.070	59.87	870.4	819.0	616.9	1023.7	1195.2	58.9
D_8	1.161	64.98	856.9	819.2	603.8	1020.1	1185.5	59.4
D_9	1.252	70.08	855.9	820.0	602.7	1020.7	1185.3	59.4
D_{10}	1.344	75.12	870.4	820.5	616.5	1025.1	1196.2	59.0

NOTE:

1. Cascade inlet operating conditions are presented in Table VII
2. Traverse plane D-D' is located 2.688 inches downstream of the leading edge plane in the chordwise direction (98.36% of chord) as shown in Figure 14
3. LV data obtained using 0.3 micron mean diameter alumina seed material

APPENDIX H

LASER VELOCIMETER DATA — CASCADE PASSAGE CENTERLINE AND CONE PROBE TRAVERSING PLANE

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TABLE XXI

LASER VELOCIMETER DATA FOR CENTERLINE TRAVERSE OF CASCADE PASSAGE NO. 3 — STATIC PRESSURE RATIO = 1.468

Data Point Identification (Ref. Figure 19)	Measurement Location - Inches Tangentially From Blade #3 Chord	Measurement Location- % Chord	Blue Line Velocity Component (Ft/Sec)	Green Line Velocity Component (Ft/Sec)	Axial Velocity (Ft/Sec)	Tangential Velocity (Ft/Sec)	Resultant Velocity	Flow Direction -Ref. Axial- (Degrees)
E_0	0.894	-1.12	962.1	925.1	676.5	1150.6		59.5
E_1	0.894	6.20	980.3	926.2	693.8	1156.5		59.0
E_2	0.894	13.51	999.2	948.3	706.0	1182.9		59.2
E_3	0.894	20.83	999.0	952.6	704.6	1186.9		59.3
E_4	0.894	28.15	984.9	954.5	690.5	1185.0		59.8
E_5	0.894	35.47	982.4	954.2	688.3	1184.1		59.8
E_6	0.894	42.79	1020.8	1018.4	707.9	1256.2	1441.9	60.6
E_7	0.894	50.10	1019.2	948.3	725.2	1188.3	1392.1	58.6
E_8	0.894	57.42	1014.0	944.0	721.3	1182.8	1385.4	58.6
E_9	0.894	64.74	1017.0	936.7	726.3	1176.5	1382.6	58.3
E_{10}	0.894	72.06	1002.6	929.5	714.4	1165.7	1367.2	58.5
E_{11}	0.894	79.38	1020.5	935.1	730.1	1176.0	1384.1	58.2
E_{12}	0.894	86.69	1036.2	935.4	745.1	1180.4	1395.9	57.7
E_{13}	0.894	94.01	1023.4	937.3	732.3	1178.8	1387.8	58.2
E_{14}	0.894	101.33	1019.3	945.5	726.1	1185.6	1390.3	58.5
E_{15}	0.894	108.65	1022.1	946.3	728.5	1187.2	1392.9	58.5
E_{16}	0.894	115.97	1022.8	948.7	728.6	1189.6	1395.0	58.5
E_{17}	0.894	123.28	1011.7	937.4	721.0	1175.7	1379.2	58.5
E_{18}	0.894	130.60	1002.5	928.3	714.5	1164.5	1366.2	58.5
E_{19}	0.894	137.92	996.6	925.0	709.8	1159.7	1359.7	58.5
E_{20}	0.894	145.24	994.0	921.7	708.2	1155.9	1355.6	58.5

NOTE:

1. Cascade inlet operating conditions are presented in Table VII
2. The chordwise traverse plane is shown in Figure 14
3. LV data obtained using 0.3 micron mean diameter alumina seed material

TABLE XXII

LASER VELOCIMETER DATA FOR CENTERLINE TRAVERSE OF CASCADE PASSAGE NO. 3 — STATIC PRESSURE RATIO = 2.220

Data Point Identification (Ref. Figure 19)	Measurement Location - Inches Tangentially From Blade #3 Chord	Measurement Location- % Chord	Blue Line Velocity Component (Ft/Sec)	Green Line Velocity Component (Ft/Sec)	Axial Velocity (Ft/Sec)	Tangential Velocity (Ft/Sec)	Resultant Velocity (Ft/Sec)	Flow Direction -Ref. Axial- (Degrees)
E_0	0.894	-1.12	959.4	963.4	663.6	1186.9	1359.8	60.8
E_1	0.894	6.20	942.9	945.9	652.4	1165.4	1335.5	60.8
E_2	0.894	13.51	954.7	950.9	662.5	1173.4	1347.5	60.6
E_3	0.894	20.83	947.7	950.1	655.9	1170.1	1341.9	60.7
E_4	0.894	28.15	938.0	926.1	653.0	1145.0	1318.1	60.3
E_5	0.894	35.47	916.4	904.6	638.1	1118.4	1287.6	60.3
E_6	0.894	42.79	902.7	893.8	627.8	1104.3	1270.3	60.4
E_7	0.894	50.10	893.5	847.5	631.4	1057.3	1231.5	59.2
E_8	0.894	57.42	894.2	846.9	632.3	1056.9	1231.6	59.1
E_9	0.894	64.74	894.3	845.8	632.7	1055.9	1230.9	59.1
E_{10}	0.894	72.06	901.7	846.0	639.7	1058.1	1236.4	58.8
E_{11}	0.894	79.38	880.7	839.9	621.2	1046.5	1216.9	59.3
E_{12}	0.894	86.69	876.2	829.9	619.5	1035.7	1206.8	59.1
E_{13}	0.894	94.01	871.6	826.8	615.9	1031.5	1201.3	59.2
E_{14}	0.894	101.33	860.5	825.3	605.6	1027.0	1192.3	59.5
E_{15}	0.894	108.65	856.5	824.8	602.0	1025.5	1189.1	59.6
E_{16}	0.894	115.97	855.8	817.7	603.2	1018.4	1183.7	59.4
E_{17}	0.894	123.28	844.8	818.8	592.3	1016.5	1176.5	59.8
E_{18}	0.894	130.60	843.1	815.6	591.6	1013.0	1173.1	59.7
E_{19}	0.894	137.92	842.6	815.4	591.2	1012.5	1172.5	59.7
E_{20}	0.894	145.24	840.1	815.3	588.7	1011.9	1170.7	59.8

NOTE:

1. Cascade inlet operating conditions are presented in Table VII
2. The chordwise traverse plane is shown in Figure 14
3. LV data obtained using 0.3 micron mean diameter alumina seed material

TABLE XXIII

LASER VELOCIMETER DATA AT CONE PROBE TRAVERSING PLANE
STATIC PRESSURE RATIO = 1.564

			Laser Velocimeter Data						Cone Probe Data	
Data Point Identification (Ref. Figure 20)	Measurement Location - Inches Tangentially From Blade #3 Chord	Measurement Location-% Chord Spacing	Blue Line Velocity Component (Ft/Sec)	Green Line Velocity Component (Ft/Sec)	Axial Velocity (Ft/Sec)	Tangential Velocity (Ft/Sec)	Resultant Velocity (Ft/Sec)	Flow Direction -Ref. Axial- (Degrees)	Flow Velocity (Ft/Sec)	Flow Direction -Ref. Axial- (Degrees)
P_0	0.257	0	974.8	899.3	695.7	1129.1	1326.3	58.4	797.5	58.2
P_1	0.346	5.0	1004.5	926.8	716.9	1163.7	1366.8	58.4	886.0	53.5
P_2	0.436	10.0	1005.9	935.3	716.0	1172.2	1373.5	58.6	1213.1	55.1
P_3	0.525	15.0	1005.2	926.6	717.6	1163.6	1367.1	58.4	1261.1	57.2
P_4	0.614	20.0	1001.0	928.3	713.1	1164.1	1365.2	58.5	1283.1	59.5
P_5	0.704	25.0	995.6	927.6	708.2	1162.0	1360.8	58.6	1312.4	61.3
P_6	0.793	30.0	997.6	925.4	710.6	1160.4	1360.7	58.5	1311.1	59.9
P_7	0.882	35.0	996.9	924.8	710.1	1159.6	1359.8	58.5	1317.6	60.3
P_8	0.972	40.0	994.0	924.4	707.4	1158.5	1357.5	58.6	1341.4	61.2
P_9	1.061	45.0	988.1	926.2	701.3	1158.6	1354.3	58.8	1363.9	61.6
P_{10}	1.151	50.0	981.8	923.1	696.1	1153.9	1347.6	58.9	1382.8	62.0
P_{11}	1.240	55.0	983.1	922.7	697.4	1153.9	1348.3	58.9	1399.6	62.2
P_{12}	1.329	60.0	985.3	924.4	699.1	1156.1	1351.0	58.8	1406.1	62.1
P_{13}	1.419	65.0	977.9	924.9	691.8	1154.6	1346.0	59.1	1400.5	61.9
P_{14}	1.508	70.0	975.7	928.3	688.8	1157.3	1346.8	59.2	1380.1	61.6
P_{15}	1.597	75.0	971.8	928.8	684.9	1156.6	1344.2	59.4	1341.6	59.4
P_{16}	1.687	80.0	981.3	930.9	693.4	1161.3	1352.6	59.2	1301.4	58.4
P_{17}	1.776	85.0	910.5	924.1	627.1	1135.7	1297.3	61.1	1282.7	58.4
P_{18}	1.865	90.0	956.3	816.8	700.2	1044.7	1257.7	56.2	1267.2	59.8
P_{19}	1.955	95.0	908.7	821.2	653.1	1036.1	1224.8	57.8	1201.7	60.3
P_{20}	2.044	100.0	-	-	-	-	-	-	872.6	57.4

NOTE:

1. Cone probe traverse plane (Ref. plane P-P' in Figure 14) is located 1.246 inches downstream of the trailing edge plane in the chordwise direction.
2. LV data obtained using 0.3 micron mean diameter alumina seed material

TABLE XXIV

LASER VELOCIMETER DATA AT CONE PROBE TRAVERSING PLANE
STATIC PRESSURE RATIO = 2.226

Data Point Identification (Ref. Figure 21)	Measurement Location - Inches Tangentially - From Blade #3 Chord	Measurement Location-% Chord Spacing	Laser Velocimeter Data: Blue Line Velocity Component (Ft/Sec)	Green Line Velocity Component (Ft/Sec)	Axial Velocity (Ft/Sec)	Tangential Velocity (Ft/Sec)	Resultant Velocity (Ft/Sec)	Flow Direction -Ref. Axial- (Degrees)	Cone Probe Data: Flow Velocity (Ft/Sec)	Flow Direction -Ref. Axial- (Degrees)
P_0	0.257	0	825.0	726.3	598.2	922.1	1099.1	57.0	980.3	54.6
P_1	0.346	5.0	845.3	744.8	612.8	945.4	1126.7	57.1	1140.1	55.6
P_2	0.436	10.0	856.5	747.6	622.8	951.1	1136.9	56.8	1164.0	56.4
P_3	0.525	15.0	841.7	746.5	608.8	946.1	1125.0	57.2	1112.2	56.9
P_4	0.614	20.0	841.9	745.9	609.2	945.5	1124.8	57.2	1002.0	56.9
P_5	0.704	25.0	817.1	744.4	585.7	937.4	1105.4	58.0	988.8	57.0
P_6	0.793	30.0	816.7	744.2	585.4	937.1	1104.9	58.0	984.9	56.8
P_7	0.882	35.0	802.4	704.5	582.3	895.1	1067.8	57.0	980.3	56.8
P_8	0.972	40.0	816.2	745.0	584.7	937.7	1105.1	58.1	984.8	56.6
P_9	1.061	45.0	828.1	745.1	596.2	941.0	1114.0	57.7	999.9	56.7
P_{10}	1.151	50.0	840.2	743.2	608.3	942.5	1121.8	57.2	1001.8	56.8
P_{11}	1.240	55.0	816.0	743.7	584.9	936.5	1104.1	58.0	1032.2	57.0
P_{12}	1.329	60.0	814.5	743.1	583.6	935.5	1102.6	58.0	1035.6	57.3
P_{13}	1.419	65.0	802.0	743.3	571.4	932.3	1093.5	58.5	1112.2	57.7
P_{14}	1.508	70.0	803.6	743.5	572.9	932.8	1094.7	58.4	1150.6	58.5
P_{15}	1.597	75.0	788.9	687.5	574.0	875.0	1046.5	56.7	1150.5	59.4
P_{16}	1.687	80.0	775.1	686.6	560.9	870.4	1035.4	57.2	952.6	59.9
P_{17}	1.776	85.0	649.6	633.5	454.4	785.4	907.4	60.0	837.6	59.4
P_{18}	1.865	90.0	640.0	633.5	446.1	783.1	901.2	60.3	787.0	56.1
P_{19}	1.955	95.0	-	-	-	-	-	-	854.3	54.2
P_{20}	2.044	100.0	-	-	-	-	-	-	954.4	54.5

NOTE:

1. Cone probe traverse plane (Ref. plane P-P' in Figure 14) is located 1.246 inches downstream of the trailing edge plane in the chordwise direction
2. LV data obtained using 0.3 micron mean diameter alumina seed material

LIST OF SYMBOLS

A	Cascade flow area, in^2
A_S	Cascade blade surface area, in^2
B	Cascade blade span, in.
C	Cascade blade chord, in.
C_D	Drag coefficient (drag force referenced parallel to blade chord normalized by inlet dynamic pressure, span, and chord)
C_L	Life coefficient (lift force referenced perpendicular to blade chord normalized by inlet dynamic pressure, span, and chord)
Cp	Center of pressure, percent chord from blade leading edge
D_f	Diffusion factor
f_i	Discrete cascade exit data to be mass-averaged
$< f >$	Mass averaged variable
F	Force exerted on cascade blades, lbs
F_c	Force coefficient (blade force normalized by inlet dynamic pressure, span, and chord)
g	Gravitational constant, 32.175 ft/sec^2
i	Incidence angle, degrees
k	Ratio of specific heats, $k = 1.4$
m	Mass flow rate per passage per inch span, lbs/sec-in.
M_{LE}	Moment exerted on blade about leading edge, lb-in.
$M_{C_{LE}}$	Moment coefficient (moment exerted on blade about leading edge normalized by inlet dynamic pressure, span, and chord squared)
Mn	Mach number

LIST OF SYMBOLS (Continued)

N_R	Reynolds number based on blade chord
P	Static pressure, psia
P_R	Static pressure ratio
P_{R_T}	Total pressure ratio
P	Total pressure, psia
Q	Dynamic pressure, psi
R	Gas constant, 53.34 $\frac{\text{ft-lb}}{\text{lb-}^\circ\text{R}}$
RMS	RMS deviation from the mean value
s	Blade spacing, in.
S	Static pressure rise parameter
T	Static temperature, °R
T_{AD}	Adiabatic wall temperature, °R
T_T	Total temperature, °R
V	Flow velocity, ft/sec
ΔV	Flow velocity change, ft/sec
X	Distance in axial direction, in.
Y	Distance in tangential direction, in.
β	Flow angle, angle between flow velocity and axial direction, degrees
$\Delta\beta$	Turning angle, degrees
γ	Stagger angle, angle between blade chord and axial direction, degrees
$\delta°$	Deviation angle, degrees
Δ	Compression or expansion of nozzle flow field by cascade wedge, degrees

LIST OF SYMBOLS (Continued)

θ_{TS}	Test section angle, angle between wind tunnel axis and tangential direction, degrees
θ_w	Wedge angle, angle between wedge surface and axial direction, degrees
κ	Angle, degrees
μ	Dynamic viscosity, $\frac{lb}{sec\text{-}ft}$
ν	Kinematic viscosity, $\frac{ft^2}{sec}$
ρ	Flow density, lb/ft^3
ψ_p	Conical probe angle, angle between probe centerline and tangential direction, degrees
ω	Total pressure loss coefficient
ω_p	Total pressure loss parameter

Subscripts:

0	Nozzle exit condition
1	Cascade exit station
A	Arithmetic mean
C	Calculated from continuity equation
eq	Equivalent
F	Force
FS	Freestream condition
i	Reference position
ID	Ideal
L	Local

LIST OF SYMBOLS (Continued)

ML	Mean line
P	Probe
PS	Pressure surface
R	Resultant force
SS	Suction surface
TE	Trailing edge
X	Axial direction
Y	Tangential direction

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